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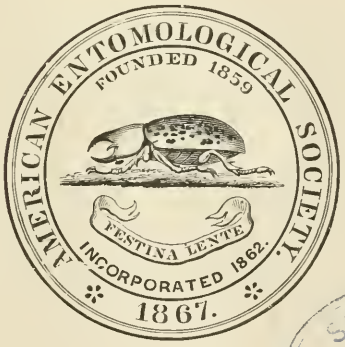


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TRANSACTIONS

OF THE

AMERICAN ENTOMOLOGICAL SOCIETY.

VOLUME XX.

## SPHINGES AND BOMBYCES.—A REVIEW.

BY JOHN B. SMITH, SC. D.

**A Synonymic Catalogue of Lepidoptera Heterocera (Moths)** by W. F. Kirby, F.L.S., F.E.S., etc. Vol. I, Sphinges and Bombyces. London: Gurney & Jackson, 1892. i—xii et 1—951.

Mr. Kirby has given us under the above title a very useful and necessary work. It makes no pretense to completeness of references, but he has "endeavored to quote all important original references to foreign species." Under this head come the American forms. Taken altogether, the volume represents an amount of labor, of which no one who has not done similar work can have the least conception. So far as I have had occasion to test the references they are accurate. Mr. Kirby makes some distinct departures in this catalogue, and his order of families and genera is quite unlike that accepted in our lists and literature. The work is an expensive one, and this will serve at least in part, as an excuse for a somewhat lengthy review of the book, giving the main features as they apply to our fauna.

In the first place, Mr. Kirby has "excluded the Ægeriidæ, Thyrididæ, Euschemidæ, and a large part of the Chrysaugidæ and Melameridæ from the Sphinges and Bombyces," and as to the Sesiidæ

at least, with perfect correctness in my opinion. It would have been better to have gone yet further and excluded the Cossidæ and Hepialidæ. The former family has very distinctive Pyralid characters and has little to associate them with either Sphinges or Bombyces. The Hepialidæ are still more unique, and Prof. Comstock has recently pointed out that with the Micropterygidæ they share a character not elsewhere found in the Lepidoptera and again found in the Phryganæidæ.

Family I is the Castniidæ, family II is the Cocytiidæ, family III, the Uraniidæ, under the first of which only are there any North American species. *Megathymus* is, in my opinion, a true butterfly—not a moth.

Family IV, the Agaristidæ, contains of our forms, the genera *Pseudalypia, Alypiodes, Androloma, Alypia, Psychomorpha, Euedwardsia, Copidryas, Fenaria, Euthisanotia* and *Ciris*. Under *Alypiodes* we have *crescens* Wlk., with *grotei* Bdv. and *flavilinguis* Grt., as synonyms; and *bimaculata* H.-S., with *trimaculata* Bdv. as synonym. The identification of *grotei* and *flavilinguis* with *crescens* is correct, as I have previously pointed out (Can. Ent. June, 1892), and I am inclined to believe that the other names also refer to the same species, and that *bimaculata* H.-S. must be used to indicate our form as is done in my Check List.

To *Androloma*, which is given generic rank, are referred the *Alypia lorquinii, maccullochi, ridingsii, similis* and *brannani* of my list. The genus *Fenaria* is used for *sevorsa* Grt., and *Phægorista* (not *Phægarista*, as I have it) is placed in the Nyctemeridæ, a widely separated family. *Euthisanotia* Hüb. is used in the sense that we use *Eudryas*, and *unio* is given as type of the genus. I am not prepared to assent to this decision without more investigation. I am inclined to believe that Boisduval's name *Eudryas* can be rescued for use as in our lists. The use of the other generic terms accords with our own. *Metagarista ? sabulosa* Bdv., illustrated in Felder Lep. iv, t. 107, fig. 11, is credited to California. I do not know the species.

Neither the Chalcosiidæ, nor the Thymaridæ are credited with species from our fauna.

The term Zygænidæ is used in the widest possible sense, except that the Agaristidæ included by Mr. Grote are here excluded, and one hundred and sixty-five genera are accredited to the family. It would be difficult, indeed, to get a definition of this assemblage with-

out including also one-third of the other families of Lepidoptera. Nine subfamilies are, however, recognized, which may be taken up in order.

In the first subfamily, the Anthroceridæ, no species from our fauna are listed. In the Adscitinæ we find Mr. Hy. Edwards' species, *Penthetria*, under the name *Tantura*, the former genus being marked pre-occupied. I am very doubtful, indeed, whether our species are near enough to *Adscita*, as *Ino* Leach is here termed, to belong to the same family, but I agree with Mr. Kirby in giving at least a subfamily rank to the differences between *Ino* (*Adscita*) and *Zygæna*. I have elsewhere pointed out an essential difference in the venation between these forms. In the appendix *Thia extranea* Hy. Edw. is referred to this subfamily. In the Zygæninæ no species are credited to our fauna, nor are there any in the Thyratinæ or Phaudinæ.

To the Pyromorphinæ, Acoloithus, Harrisina, Triprocris, Pyromorpha, Lycomorpha and Anatolmis are referred; though I have pointed out that there are essential differences between *Anatolmis* and *Lycomorpha* and the other genera with which they are associated by Mr. Kirby. With these two genera excluded Mr. Kirby includes of our fauna the species ranged under the term Pyromorphidæ in my list. *Triprocris aversus* Hy. Edw. is erroneously recorded as from Arizona, whereas it was described from Jalapa, Mexico. *Lycomorpha rata* belongs to *Pyromorpha* as referred in my list.

The Euchromiinæ contain the largest series in the "Zygænidæ," and of our species has *Syntomeida ipomeæ* Harr., using this generic term instead of *Euchromia*, and citing *ferox* Wlk., and *euterpe* H.-S. as synonyms; *Dahana atripennis; Phyllœcia* (Guér.) *texanus* for *Horama texana; Erruca pertyi, Didasys belæ* and *Cosmosoma auge* Linn. (= *omphale* Hüb.). *Burtia rubella* from Cuba, so close to *Didasys belæ* that they seem like the same species, and are certainly identical generically, is placed in the Trichurinæ under Herrich-Schaeffer's name *Gundlachia*. *Syntomeida epilais* is not credited to Florida, though well recorded thence.

Neither the Trichurinæ nor the Antichlorinæ are represented in our fauna.

The Arctiidæ are ranged in six subfamilies and two hundred and thirty-one genera, introducing a great many changes in the accepted nomenclature.

In the Charideinæ, containing thirty-eight genera and many species, our own fauna is represented only by *Nelphe carolina* Hy. Edw.

and the species of *Scepsis*. Whether *N. carolina* agrees with the other species of *Nelphe* or not I cannot say; it is certain, however, that it has no family relationship with *Scepsis*. Why this latter genus is disassociated from *Ctenucha* is a puzzle to me, in all details of structure they are closely related, and only the wing form differs. *Sc. packardii* is referred as a synonym of *Sc. fulvicollis*, perhaps correctly.

The Ctenuchinæ are all American, and a fair proportion from our fauna. *Ct. venosa* Wlk. is referred to *Philoros*, and is type of the genus. *Ct. virginica* is type of *Ctenucha*, and has associated with it only one other species. *Ct. cressonana* is referred to *Compsoprium* Blanch. To *Euctenucha* are referred *ochroscapus*, *multifaria*, *rubroscapus*, *sanguinaria* and *brunnea* of our species, while in *Pygoctenucha* we find *robinsonii*, *funcra* and *harrisii*, the latter of these the type of the genus. There is room for a difference of opinion at least on the question of the necessity for so many genera for so few species.

The Pericopinæ, again, are very poorly represented from our fauna. The species of *Gnophæla* are arranged somewhat differently from the accepted method. *Hopfferi* is made a synonym of *latipennis* Bdv., while *discreta* is given specific rank, and *arizonæ* is cited as a synonym. The validity of this synonymy is at least open to question. *Daritis* and *Composia* are the only other genera represented in our fauna, each by a single species only. *C. fidellissima* is not credited to our fauna, though both Mr. Dyar and Prof. French have recorded it. In my Check List it appears among the Agaristidæ; probably an error.

In the Phægopterinæ we find, first, *Alexicles aspersa* Grt., which is unknown to me, *Eupseudosoma floridum*, *Lophocampa* with *caryæ* as type, and *agassizii*, *maculata*, *argentata*, *sobrina*, *scapularis*, *ingens*, *occidentalis* and *subalpina* as other species; *Euhalisidota*, *Halisidota* with *tesselaris* as type, and *davisii*, *labecula*, *edwardsii*, *cinctipes*, *minima*, *trigona*, *cinnamomea*, *significans* and *ambigua*, as other species.

In *Lophocampa*, *agassizii* is given as distinct from *maculata*, with *californica*, *angulifera* and *salicis* as synonyms; *fulvoflava* and *guttifera* are cited as synonyms to *maculata;* otherwise, no changes are made. In *Halisidota* we find *trigona* Grt., but *specularis* H. S., which resembles it so closely that it has been considered identical, does not appear in the genus; so of *H. roseata* Wlk., which has been cited as a synonym of *cinnamomea*. *Cinctipes* Grt. is not credited to our fauna, though it has been well recorded from it.

Under *Ecpantheria* we find *sennetii* Lint., then *cæca* Strk., our old friend *scribonia* under the name *ocularia* Fab., *cunigunda* being awarded specific rank, and *reducta* Grt.; *cæca* Strek. and *reducta* Grt. have long since been referred as synonyms of *Leucarctia permaculata*, which is in truth an *Ecpantheria*, though it does not appear in Mr. Kirby's list.

*Halisidota roseata* reappears as a species under *Æmelia*, widely separated from *H. cinnamomea* Bdv., and we are again at sea as to what was intended by these specific names.

Under *Arachnis* we find *zuni* credited to Mr. Schaus, while Mr. Neumoegen is entitled to the honor.

Subfamily V, the Spilosomatinæ, shows, as the first familiar name, *Antarctia*, to which none of our species are referred. In the appendix, however, *A. beanii* Neum. appears.

Under *Estigmene* Hüb. we find *acræa* as type, and *permaculata*, *albida* and *? niobe* Strk. as other species. *Spilosoma nigroflava* Graef., is cited as a synonym to *E. permaculata*, to which it has not the slightest resemblance. *E. niobe* Strk. has been referred to *Seirarctia echo*. *E. permaculata* Pack. is an *Ecpantheria*, as has been already stated. *Cycnia dubia* Wlk., appears here as an *Estigmene;* Messrs. Grote and Robinson, from an examination of the type, referred it to *Phragmatobia*.

*Spilosoma* is unchanged. In *Hyphantria* we have *cunea*, *textor* and *punctata* as good species, though their identity has been proved to demonstration time and again. *Spilosoma congrua* Wlk, correctly appears as a synonym of *H. cunea*. Why Mr. Kirby restored these specific terms when there is practical unanimity among American students in referring them to the synonymy, puzzles me.

*Ectypia bivittata* should have *Spilosoma nigroflava* as a synonym. *Euerythra*, wrongly written in the body of the work, is corrected in the appendix.

*Cycnia* Hüb. is used for most of our species of *Euchætes*, and *C. tenera* Hüb., from the "Southern States," is named as type. We find also *C. budea* Hüb. as from the same locality. I am not aware that either *tenera* or *budea* are known in our collections. In *Parenchætes* we find *cadaverosa*, *affinis* and *conspicua*. If the genus is a good one, other species must be referred to it. *Vanessodes* is sandwiched in here, though it has little resemblance to those of the surrounding forms that are known to me. *Seirarctia* is unchanged, and so is *Pyrrharctia*, which ends the subfamily.

The subfamily Arctiinæ begins with *Codiosoma*, as Mr. Kirby writes Mr. Stretch's generic term *Kodiosoma*. *Phragmatobia* follows immediately after, and contains, besides *fuliginosa* and *rubricosa*, the species we have as *Antarctia* in our list. I confess this aggregation is staggering, when the separations elsewhere made are taken into consideration. *P. assimilans* is cited as a synonym of *rubricosa*, and *franconia* is cited as a variety of the latter, probably quite correctly. *P.* (*Antarctia*) *vagans* Bdv. has *rufula* cited as a synonym—quite correctly in my opinion; but *walsinghami* has no better claim to specific rank, and is yet passed.

*Parasemia* Hüb. is used instead of *Nemeophila*, with *plantaginis* as type. *Geometrica* is cited as distinct from *petrosa* contrary to the opinions of all American entomologists; even its describer, Mr. Grote, placing it as a variety as far back as 1889.

*Haploa* Hüb. is used for our American species referred to *Callimorpha*, the synonymy practically agreed upon by Mr. Lyman and myself being mostly rejected and nearly all the names given specific rank. Whether Mr. Kirby deems our work inconclusive or unreliable does not appear. The only point he decides is that *C. lactata* Smith drops in as a synonym of *Tanada conscita*, and that perhaps may be conceded as correct.

Under *Callimorpha*, Mr. Kirby gives us our *Epicallia virginalis*, making it congeneric with *C. dominula* L., the type of the genus. In *Platarctia*, *parthenos* and *borealis* appear as distinct species, and *hyperborea* Curtis, to which both have been referred as synonyms, does not appear in the genus at all. *Yarrowi* and *remissa* also are referred to this genus.

Under *Hypercompa* Hüb. we find our *Euprepia caja* and *opulenta*. Mr. Kirby here gives the Tentamen priority over Ochsenheimer's name. My opinion of the Tentamen has been elsewhere expressed, and I cannot follow Mr. Kirby here.

Under *Arctia* we have *villica* as type, and one other species, none of our American forms being accredited to the genus.

In *Hyphoraia* Hüb. we find our *Platarctia hyperborea*, its supposed synonyms *parthenos* and *borealis* having been long ago disposed of.

After an interval of foreign generic names we find *Apantesis* Wlk., to which most of the *Arctia* species of our list are referred: such as are not so found will be hereafter mentioned. *Arctia parthenice* is given specific rank and widely separated from *saundersii*, of which it is, I believe, a synonym; indeed, the order of species here adopted

is entirely unnatural, and without any base discoverable by me. *Stretchii* is separated by *shastaensis* from *intermedia*, of which it has been referred a synonym. *Shastaensis*, by the bye, is credited to French instead of Behr., and quite correctly, for the characterization is by French, and the use of a mss. name suggested by another does not change the authorship. Other departures from well-established synonymy are numerous, and Mr. Kirby seems to have been quite arbitrary in his recognition or rejection of species. All of Mr. Butler's names, baseless as most of them are, stand of course, since the types are in the British Museum, but why *anna* and *persephone* should be kept distinct when no American entomologist disputes their specific identity is puzzling, especially when *nevadensis* and *incorrupta*, which are related in much the same way, are classed as varieties.

Under *Orodemnias* we find *quenselii* with *gelida* as synonym, *speciosa* as a good species, *obliterata* and *cervinoides*. In *Callarctia* we have *ornata*, *proxima*, *favorita* and *arizonensis*. Under *proxima*, which is not credited to our fauna, we find *docta*, *mexicana* and *antheola*, as synonyms, correctly enough; *arizonensis* should have been added.

In *Leptarctia* the names are arranged according to French and Butler.

Family IX, the Cymbidæ, contains only one familiar name—*Earias obliquata* Hy. Edw. It seems to be the only species in the family recorded from the New World, and the correctness of the generic reference may bear investigation.

Family X is the Lithosiidæ, with 228 genera not divided into subfamilies. The first familiar name is genus 11, *Hypoprepia*, under which our species are arranged as we are accustomed to see them. Genus 12, *Cisthene*, contains all the names proposed for our forms, and specific rank is accorded to all. Genus 13, *Pyralidia*, replaces *Byssophaga*, as used in our lists, and *deserta* Felder, from Utah, is named as type. I do not know this species and question its distinctness from our other named forms.

Genus 14 is *Hyaloscotes* for *fumosa* Butler, and then there is a long array of genera without a familiar name until 92, *Lithosia*, is reached. Here we find *argillacea* with *bicolor* as synonym, and *rubropicta*. Why *argillacea* is preferred to *bicolor* does not appear: both names were proposed in the same volume of the same publication, but *bicolor* has, according to Mr. Kirby, twenty-four pages the priority,

and is yet ranked as a synonym. In genus 122, *Crambidia*, we recognize another acquaintance, and under it are *pallida* as type, and *Lithosia candida*, *casta* and *cephalica* as other species. Genus 126 is *Eustixia* Hüb., with *pupula* as type and sole species. This is undoubtedly a Pyralid, and has been so referred by Prof. Fernald in the recent Check List. Genus 144 is *Coscinia* Hüb., and among others we find our *Emydia ampla* under this generic name. *Utetheisa* is genus 147, containing among others our species *ornatrix*, *bella*, *venusta* and *pulchella*, all as good species; *venusta* Dalm. is an older name for *speciosa*; so Mr. Kirby says. Under *Eubaphe* Hüb., genus 163, we find our species of *Crocota*, in which little change is ventured. Genus 166, *Eudule* Hüb., contains our *Ameria texana* and *unicolor*, and *Crocota immaculata* Reak. Genus 179 is *Pagara* Wlk., with *simplex* as type, and *murina* as synonym. I have shown, "Canadian Entomologist," xxiv, 134, that these are the same as *Vanessodes clarus* G. & R., which Mr. Kirby makes genus 160 in the Arctiidæ, placing it next to *Euchætes*. The present location is much the better. Mr. Kirby is certainly in error in citing *simplex* as the type of the genus; *venosa* was first described under the name, and *simplex* under another name is the type of *Comacla*. If *venosa* is really congeneric with the others, it makes no difference which is selected, otherwise *Comacla* has the right to recognition. Genus 182 is written *Euphanessa*, and contains our species and two others. *Clemensia* is genus 190, and contains our species and one other from Brazil. Under *Nycteola* we have our species referred to *Sarrothripa*. I think that these species are certainly entitled to family rank; there is more difference structurally between *Nycteola* and *Lithosia* than between the latter and *Arctia*. *Eulithosia* Hy. Edw., genus 199, is a Noctuid, as I have shown. To *Nola* 72 species are referred, among which the four names credited to our fauna make a poor showing. In *Argyrophyes*, however, we have two of the three species, and under *Lebena*, genus 210, we find our *Nola trinotata*, *minna*, *sorghiella* and *melanopa*. To the remaining genera no American species are referred.

Family XI, the Hypsidæ, family XII, the Callidulidæ, and family XIII, the Cyllopodidæ are not represented in our fauna.

In Family XIV, the Dioptidæ, *Phryganidia californica* is the only species from our fauna.

Family XV, the Nyctemeridæ, are altogether unrepresented.

Family XVI, the Liparidæ, contains 180 genera, among which

American forms are sparsely represented. The first genus credited to the United States is number 9, *Cingilia* Wlk., with *humeralis* Wlk., as sole species and type. This is one of those unfortunate overlooked species that has never made its way into our lists; what it may be is unknown to me. In genus 22, *Carama*, we are represented by *cretata* Grt. So in genus 61, *Artaxa*, we are credited with one species out of 61, and even this has a ? after the generic name, as if to question its right here. As there seem to be no other species known from the New World, perhaps the ? is justified.

In *Parogyia*, genus 110, we make a better showing with eight species out of sixteen described. Mr. Kirby credits *basiflava* Pack., to locality "Nonantum." It would puzzle some of our foreign friends to know where this place was if the name of the describer and place of description did not suggest the United States as the probable location. Apropos of this it may be noted that Mr. Kirby often gives for our American species only the localities given in the original description, so that as a guide to distribution within our fauna the catalogue is of little value. Thus under *Lagoa*, genus 113, *pyxidifera* and *opercularis* are credited to Georgia only, and *crispata* to Massachusetts only. Under genus 135, *Dasychira*, we have *rossii*, *grœnlandica* and *lintneri* from our fauna. *Demas diversicolor* Morr. and *D. flavicornis* Smith appear under *Colocasia* Ochs. Mr. Morrison's species has long since been referred to *Hadena*, while my species is certainly a Noctuid, and is congeneric with *coryli*. *Nerice* Wlk., genus 147, also figures as a *Liparid* here. *Cothocida nigrifera* Wlk., genus 154, is a *Crocota*, as I have shown. In genus 157, *Hypogymna morio*, is credited to Europe and America, without specifying North or South. It is not known to me from our faunal region.

Our species of *Orgyia* reappear in genus 164, under the term *Notolophus* Germ., with *antiquus* as the type, *O. fascelina* being made the type of Ochsenheimer's genus, to which we have nothing to refer, generically. Mr. Edwards' *obliviosa* appears as *olivacea* and a var. of *leucographus* Geyer.

In family XVII, the Heterogynidæ, we are not credited with any species, and the entire family contains only one genus with three species.

Family XVIII is the Psychidæ, with 49 genera. Genus 2 is *Oiketicus*, in which we have two species. Genus 3 is *Thyridopteryx*, in which also we have two species. Under genus 8, *Manatha* Moore, we find *M. edwardsii* Heyl., from Texas; a name heretofore unknown

to me as the species is at present. We also find under genus 25, *Chalia riley*i Heyl., also from Texas, and equally unknown to me. *Psyche* is genus 32, and under this our four species form just one-fifth of the whole. *Platyceticus* is genus 33, with *gloveri* as type, and one other species. For *Eutheca mora* Grt., accidentally omitted from my list, *Sapinella*, genus 45, is proposed, Mr. Grote's name being preoccupied, and the same fate befalls *Pseudopsyche* Hy. Edw., for which we get *Œdonia* Kirby. The genera *Lacosoma* Grt., and *Perophora* Harris, are referred to the Drepanulidæ by Mr. Kirby; perhaps incorrectly.

Family XIX is the Limacodidæ, with 106 genera. Not till we get to genus 33 do we strike a familiar name, and then we find *Limacodes beutenmulleri* Hy. Edw., under *Semyra* Wlk. Genus *Phobetrum* Pack., or *Phobetron* Hüb., as under the rules it should be written, contains *pithecium, hyalinum, nigricans* and *tetradactylus;* all, save the first, long since placed in the synonymy. Genus 10, *Adoneta*, contains our species only. Under *Eulimacodes* we find *scapha* Harr. *Nochelia* and *Empretia* are genera 52 and 53, respectively, each with the single type species only. Under *Sibine* H.-S. we find referred with a ? the *Limacodes ephippiatus* of the Harris correspondence. This is obviously *Empretia stimulea*, and very well characterized; but I have no memorandum that it has ever been definitely referred into the synonymy. *Parasa* is genus 67, and contains 54 species, only two of them from our fauna. *Varina ornata*, which follows next after, has been removed from this family by Mr. Dyar, whose recent papers on this family Mr. Kirby has used in the appendix to supplement his text. *Euclea* and *Monoleuca* are genera 69 and 70, respectively. Under *Euclea* we find *viridiclava* Walk., from Massachusetts—a name unfamiliar to our lists. Referring to Walker's description we find that no locality was there given, except a ?, and perhaps the Massachusetts locality by Mr. Kirby is an error. *Isa* Pack. is said to be preoccupied, and *Sosiosa* Kirby is proposed to replace it. Next after this comes *Tortricidia*, in which *flavula* and *pallida* are given specific rank, and to which the undetermined *Limacodes ferrigera* Wlk. is added. *Kronea* is genus 82, and contains our species only. Our species of *Limacodes* appear under *Apoda* Haw., and *Limacodes* is made a synonym and not used for any aggregation of species. Whether under such conditions we can use the family term Limacodidæ, there being no genus *Limacodes*, is perhaps a question. Personally, I would regret the change, as I regret the

change from the well and universally known *Limacodes* to *Apoda*. Several of the species under the typical name in our lists are elsewhere referred; but no synonymical changes appear. *Sisyrosea* (wrongly written *Sicyrosea*) contains the species *inornata*, *nasoni* and *rude*. It has been shown that *inornata* is the type of *Isa*, and not *textula* H.-S., though as the name is preoccupied, Mr. Kirby's solution may be accepted. *Rude* has been referred as a synonym of *nasoni*. Under *Packardia*, genus 90, *ocellata* and *nigopunctata* appear as good species, though they have been referred to the synonymy. Under *Lithacodes* we have *fasciola*, *laticlavia* and *rectilinea*, referred to *Limacodes* in my list, and *flexuosa*, *cæsonia* and *graefii*, there referred to *Heterogenea*. The generic reference in my list may be incorrect, but *graefii* and *flexuosa* have been referred as synonyms of *textula* H.-S. Under *Heterogenea*, *shurtleffii* appears as sole American species. If it is really the same as *cæsonia*, and the latter is really a *Lithacodes*, this leaves us no representative of this old world genus.

Family XX, the Notodontidæ contains 202 genera. Genus 12, *Litodonta*, with *hydromeli* as type and sole species, is the first name in our lists. *Heterocampa* follows, containing our species with two exceptions, elsewhere referred to. *H. trouvelotii* is given specific rank, though it has been referred as a variety of *obliqua*, and *marina*, also given as a species, has been placed as a synonym of *unicolor*. Under *Œdemasia* we have the species usually in our lists, and in addition the *Dryocampa riversii* Behr. and *Edema semirufescens* Wlk. The latter was referred to *Schizura unicornis* many years ago by Grote and Robinson, as I believe, correctly. *Schizura* is genus 23, and contains all our American species; *humilis* and *edmandsii* having specific rank, though they have been referred as synonyms to *unicornis*. Genus 25, *Saligena* Wlk., with its single species *personata*, has been long ago referred as a synonym of *Raphia frater* Grt. *Seirodonta* follows, and contains only the typical species. *Hatima* Wlk., is next, with *semirufescens* Wlk. as type, and *Dasylophia anguina* and *interna* as other species. I have, from an examination of the type, referred (Can. Ent. xxiv, 35) *H. semirufescens* to *Schizura unicornis* and the species of *Dasylophia* are certainly not congeneric. By a *lapsus calami* I wrote the name *Hatuna* in my original note and so it was printed. *Dasylophia* must assuredly be restored. *Ianassa lignicolor* is type of its genus, and *Edema transversata* is referred to it as a synonym. I have examined the type and have referred it to *Ellida gelida* Grt. in Can. Ent. xxiv, 135. Genus *Symmerista* Hüb.

is number 34, and has as type *S. albicosta* Hüb. This species was figured by Hübner as European, and was said by Treitschke, v, 2, 167, to be *albifrons* H.-S., with an erroneous locality. Mr. Dyar seems to think it a good species, and that it may not even be congeneric with *albifrons*. I do not know it. *Edema* contains of American species, besides those in our list, *obliqua* Wlk., and *plagiata* Wlk. The former has been placed in the synonymy among the Noctuidæ; the latter was referred to *Parorgyia* by Messrs. Grote and Robinson from an examination of the type. Genus 41 is *Stretchia* Hy. Edw., with *plusiiformis* as sole species and type. As far back as 1882, Mr. Grote referred this genus to the Noctuidæ and as a synonym of *Perigrapha*. *Acherdoa* (not *Acherdes*, as Mr. Kirby writes) *ferraria* has been referred as identical with *Varina ornata* Neum. (Can. Ent. xxiv, 135), and is surely not a *Notodontid*. It is pleasant to find Mr. Kirby wrong and myself right in transcribing, once in a while; the boot is too often on the other leg. I realize too well the absolute impossibility of getting so vast a body of names rightly written, to make it a subject of criticism. *Certila flexuosa* I do not know; it is one of the undetermined Walker species. *Hyparpax*, genus 82, contains our species only. *Psaphidia* Wlk., with *resumens* as sole species and type, is a noctuid. My catalogue of this family is in the printer's hands and I cannot say from recollection what species it is a synonym of. In *Cerura*, *cineroides* and *candida* are both given specific rank, and *bicuspis* is not credited to America. Under *Panthea* we find *leucomelæna* Morr., which has been for many years recognized as a synonym of *Audela acronyctoides* Wlk., and so appears in Mr. Grote's list of 1882. The genus is certainly noctuid, by the bye, and we have a number of species fully referable to it. In *Gluphisia*, all our species appear as listed; *tearlii* has been referred to *Bombycia* long since and *septentrionalis* Wlk., here given specific rank, has been referred, though with a ? to *trilineata* by Mr. Grote. *Thanmetopœa* Hüb. replaces *Cnethocampa* Steph., and here we find *grisea* Neum. *Ellida gelida* Grt. appears under genus 117; as already stated, *transversata* Walk. must replace the specific name. Under *Notodonta* we have *stragula*, *basitriens*, *simplaria*, *plagiata* and *notaria* of our species. The latter has been referred to *Lophopteryx elegans* Strk. *Lophodonta* contains only the species of our list. *Ochrostigma* Hüb. replaces *Drynobia* Dup., and *tortuosa* Tepp. appears under that name. Under *Lophopteryx* our two species appear, and to *elegans* Strk., var. *a*, *orissa* Strk., is added. No change ap-

pears in *Pheosia*. *Melanopha* Hüb., Tentamen, replaces *Ichthyura* Hüb., Verzeichniss, and under that name our species are listed. *Palla* is given specific rank, and so is *indentata*, else no change is made in our species. *Apicalis* is credited to Walker instead of to Barnston, and Mr. Kirby has consistently so credited all the species described by Walker from Barnston's catalogue names; correctly so in my opinion. In *Datana*, genus 153, no change is made, and the genus contains our species only. *Nadata* contains three species beside those from our fauna; all Asiatic. No American species of *Nystalea* appears, though Mr. Grote has described an *N. indianæ* referring it to the Noctuidæ near *Cucullia*. From a casual examination of the type it is much nearer to *Bombycia*. As an ending to the family there appear 23 genera described by Walker, all save one with a single species only, and all either from Brazil or Sarawak. Whether they are all so intimately related, or whether Mr. Kirby found it impossible to place them more definitely does not appear.

As Family XXI, appear the Sphingidæ sandwiched in between the Notodontidæ and Bombycidæ. This is quite out of the accepted course, but I am not prepared to say that it is indefensible. The question of arrangement offers so many opportunities for individual judgment, as it is universally admitted that no linear arrangement can truly express all relationships, that almost any arrangement can be defended; six subfamilies with 116 genera are recognized. At the head come Macroglossinæ with *Hemaris* Dalm. as first genus. All our species are included under this term and nearly all the names are given specific rank. As to some of the forms where the synonymy is in dispute, this course was perhaps the safest, but in other cases I do not understand why Mr. Kirby ignored the conclusions reached in my monograph of the American species. Under *Lepisesia* only *flavofasciata* and *ulalume* are included. I have shown that it is much wider in its application in our fauna. Under *Aellopos*, neither *tantalus* nor *fadus* are credited to our fauna. *Euproserpinus* is used for *phæton* and *euterpe*, and *Dieneces* Butler for *clarkiæ* and *circæ*. Why eight genera, quite different in structural characters, should be placed between these genera and *Lepisesia*, is a mystery to me. Under *Perigonia* we find *tacita* Druce, from the United States. It is unknown to me. *Thyreus* is marked preoccupied, and *Sphecodina* Blanch. is used instead, with *abbotti* as type. *Amphion nessus* and *Deidamia inscriptum* are both monotypic from our fauna. *Gaurœ* and *Juanita* appear in *Pterogon*. I have shown that the

genera last cited (except *Pterogon*) are structurally distinct from the typical Macroglossinæ, and that they cannot remain united with it. *Unzela japix* is credited to America simply. I am not aware that it occurs in our fauna. *Triptogon* is used for *Enyo*, marked preoccupied, and neither *lugubris* nor *eamertus* are credited to our fauna.

The Chœrocampinæ are Subfamily II. *Theretra* Hüb. is used for *Chœrocampa*, and out of 115 species our fauna is credited with two only, and one of these—*procne*, does not belong to us. *Deilephila* contains two species from our fauna, and one of these is *galii*, var. *intermedia* Kirby, to which *chamœnerii* is cited as synonym; probably correctly. *Dupo* Hüb. is used for *vitis*, *linnei* and *typhon*, while in *Philampelus* we find *pandorus*, and in *Pholus*, *achemon*. This is certainly extreme, for, while we may admit difference between *Dupo* and *Philampelus*, *achemon* and *pandorus* are so closely allied in all stages that generic separation becomes simply absurd. Carried out consistently on the same basis it would be almost impossible to get more than two or three species into any genus. *Argeus labruscæ* is not credited to our fauna, though it has been in our lists for years. To *Darapsa* is referred *versicolor* Harr. *Ampelophaga* is confined to Asiatic species, and *chœrilus* and *myron* appear in *Everyx*.

Subfamily III is the Ambulicinæ, in which we find *Paehylia* Wlk. *P. ficus* is not credited to our fauna, but *P. lyncea* Clem., from Texas, appears as a good species.

Subfamily IV, the Sphinginæ, begins with *Diludia*, which contains *brontes* as sole species from our fauna. *Daremma* contains *undulosa* as type, *hageni* and *catalpæ*, all from our fauna. Mr. Kirby does not seem to have recognized the close affinity between these species and *amyntor*, for he places the latter 14 genera further on. *Dolba* has our species as type, and one other from Mexico. *Coeytius* Hüb., Verzeichniss, has *antæus* as type, *Amphonyx* sinking into the synonymy. The species is not credited to our fauna. Under *Phlegethontius* we find *sexta* Joh. as type, and this is our *Sph. carolina*. As other species we have *rustica*, credited to America simply; *dalica*, credited to Canada, and which has been referred as a form of *rustica*; *lycopersici*, which has been referred to *carolina*; *quinquemaculata* and *cingulata*, var. *decolorata*. Under *Sphinx*, *oreodaphne* is given specific rank, *leucophæta* is credited to Texas, *lugens* is not credited to our fauna, *andromedæ* is marked from Georgia to Honduras, as a good species, *utahensis* is given specific rank, *vashti*, *vancouverensis* and *albescens* are all made good species, and we find a *S.? capreolus*

Schauf., from Vermont! *Gargantua*, with *eremitus* as type, is proposed for that species, *eremitoides*, *gordius* and *luscitiosa*. Mr. Kirby seems to have overlooked the fact that Mr. Grote, ten years ago and more, referred Mr. Strecker's species to *lugens*. Under *Hyloicus* we find *saniptri* Strk. as a distinct species; *plebeia*, *dollii*, *coloradus*, *sequoiæ*, *strobi* and *cupressi*. Under *Lapara* we still have *bombycoides* Wlk. as sole species and type. *Chlænogramma* has *jasminearum* as type and only species, and *Ceratomia*, with *amyntor*, is in the same case. *Ellema* contains our species only, and *Exedrium* has still only one species. *Dilophonota ello*, *œnotrus*, *melancholica* and *meriannæ*, are all credited to America simply, though they are mostly confined to a very limited part of it. *Obscura* on the other hand, though it occurs in our fauna, is credited only to Mexico and the Antilles. Under *Cautethia* we have *grotei* only, and under *Anceryx* only *edwardsii*.

The Manducinæ, Subfamily V, contains only *Manduca* Hüb., Tentamen, which replaces *Acherontia* Ochs., and this is unrepresented in our fauna.

Subfamily VI is the Smerinthinæ. *Marumba* Moore is used in place of *Triptogon*, marked preoccupied, and we are given three species: *modesta*, *imperator* and *cablei*. The latter "species" one would suppose had certainly not a leg to stand upon, and why Mr. Kirby gives it unquestioned specific rank here is inexplicable to me. Under *Smerinthus* we have *vancouverensis* and *ophthalmicus*, while under *Eusmerinthus* we have *cerisii* and *astarte*, though I have shown that they are all but geographical races of one species. *Geminatus* is given as distinct from *Jamaicensis* under the same generic term, and here, too, we find *myops*, a species which I have shown to be structurally distinct. In *Paonias* we have *excæcata* as type, and *pavonina* Geyer as other species. To *Calasymbolus*, *astylus* is referred as type, and one other species, *oculata*, from Mexico, is given a place here with a ?. In *Cressonia* we find *juglandis*, *hyperbola*, *robinsonii* and *pallens*, all as good species. Finally, tailing off the list, we have *Arctonotus lucidus*. After such an review of the Sphingidæ, a sort of helpless feeling predominates. Is there any use of writing monographs, lists or synopses when they seem to be unused or regarded as of no avail by such men as Mr. Kirby? To say nothing of the almost entire disregard of nearly all the original synonymy proposed by me in my monograph of the family, even old, accepted synonyms, established by Mr. Grote are not adopted in all cases.

Not even for localities are our lists used, much less are our other publications referred to in matters of distribution. Demonstrations of structural identity or differences go for nothing. The races of *Smerinthus cerysii* are separated generically, while species very different in structure are associated.

To the Bombycidæ, Family XXII, only 28 genera are referred, and the first of these, represented in our fauna, is *Bombyx* with *mori* as type. I am glad Mr. Kirby has so typified the old Linnaean genus. The only other species from our fauna is *Thauma ribis* Hy. Edw., only species of the genus.

Family XXIII, the Drepanulidæ, contains 31 genera, 17, or more than half of them, monotypic. *Perophora*, with 25 species, is referred here, our fauna credited with one name only, which, however, typifies the genus. *Oreta* Wlk., supplants *Dryopteris* Grt., and our species are here listed: *marginata* is here given as a synonym of *rosea*, instead of a variety, as it stands in our lists. *Lacosoma*, with *chiridota* as type and only species, is also referred here. Under *Platypteryx*, our species appear without change, save that *fasciata* Steph. is referred to "N. Amer.?"; it is quite likely that the ? is justified. The *Prionia bilineata* of our lists reappears here in *Falcaria* Haw., and that ends our representation in the family. Scanning the association here made, rather closely, leaves it an open question whether superficial resemblances rather than structural characters have not been too much controlling.

Next follows the family Ceratocampidæ, and in *Anisota*, which heads the series, we find our three species unchanged, two of them referred from Georgia only, the third from America. *Dryocampa* follows, with *rubicunda* as type, and six other species from Central and South America. *Sphingicampa* contains our species only, and var. *immaculata* Jewett is missing. *Quadrilineata* and *albolineata* by the bye, are credited to Mexico only. *Citheronia* Hüb. and *Eacles* Hüb. are united, and our species otherwise are unchanged. *Coloradia* ends the series. Omitting the last, the family is a sharply limited one. I confess that I would have hesitated about uniting *Eacles* and *Citheronia*, but am not prepared to say the union is not justifiable. It is only surprising to find it made by Mr. Kirby, who elsewhere finds no difficulty in separating much more nearly allied forms.

To Family XXV, the Saturniidæ, 68 genera are referred. Under *Attacus* we find *cinctus*, from Arizona, and *erycina* Shaw, as doubt-

fully Texan. *Erycina* is an older name for *splendidus*, according to Mr. Kirby. Under *Philosamia*, used for a section of Hübner's *Samia*, we find *cynthia*, which is credited to Java only, though it has been on our lists for years. Mr. Kirby has in some other cases given only the original home of a species and not the localities in which it has been accidentally introduced or domesticated. *Samia* Hüb. is given *cecropia* as type, and *columbia*, *gloveri* and *californica* as other species. The last name justly replaces *ceanothi* Behr. In *Callosamia* we find *calleta*, *promethea* and *angulifera*. This separation of the species, which I have united under the term *Attacus*, is perhaps justifiable when the fauna of the world is considered, though I confess I rather doubt the possibility of sharp definitions for all of the generic terms. Under *Telea* we have *polyphemus* as sole species and type. *Luna* appears under *Tropæa*, and next to it we find *T. rossi* Ross, from Toronto. It is extremely unlikely that this name refers to a distinct species. I have not seen the "Cat. Lep. Can. p. 5, note (1872)," where it is said to be described. Under *Saturnia* we find our *galbina*, but it is credited to Mexico only. *Calosaturnia*, with *mendocino* as sole species and type, is separated from it by six foreign genera. *Automeris* Hüb., is used to replace *Hyperchiria* for 77 species, among which our few American names are scattered. *Lillith* Strck. is given specific rank. Of *Hyperchiria*, proper, we have no species. *Hemileuca* is an American genus, and all but four of the species belong to our fauna. *Nevadensis* is given specific rank, and *hualapai*, *tricolor* and *sororius*, are referred to *Euleucophœus*. *E. neumoegeni* is referred to *Argyrauges*. In *Pseudohazis*, *nuttali* is given specific rank; *pica* is made a synonym of *hera* instead of a variety of *eglanterina*, and *marcata* is made a variety of *eglanterina* instead of *hera*, as its describer thought. It is to be regretted that Mr. Kirby did not accept my limitation of the Saturniidæ to those forms in which the antennæ have two branches or pectinations to each joint. If structural characters are to be regarded as having any value at all in the Lepidoptera, this character is certainly as strong a one as occurs in the order.

Family XXVI is the Lasiocampidæ, with 148 genera. Not until we reach genus 85 do we find any familiar names, and then, under *Phyllodesma* Hüb. we find the species we have as *Gastropacha* in our lists. *G. occidentis* Wlk. is here referred as a synonym of *americana*, which I am willing to accept as correct. *Roseata* Stretch is used instead of *mildei* Stretch, and here I cannot follow Mr. Kirby. On

plate iv, fig. 12, of Mr. Stretch's work, a species is figured which, in the sheet of explanations, is called *G. roseata* N. S. No such species is described, but on p. 113 is described, at length, *G. mildei*, and, after the name, the reference is to Pl. iv, fig. 12. There is no sort of doubt that Mr. Stretch intended *mildei* as the name of the species, and that *roseata* was a mere tentative term unfortunately used in the explanations. I do not think that this constitutes such a characterization of the species as will prevent an author's changing the name in the first description, even though the plate is issued a month before the part containing the description appears. *P. alascensis* Stretch also appears in the list. Mr. Stretch never described any such species if his language is to be trusted. In comparing his *mildei* with allied species he speaks of *G. alascensis* Pack., and says his species is not "uniformly dark brown * * * etc.," quoting from some other publication. As a matter of fact, *alascensis* was never sanctioned by any description, and has no existing type. The name has no rightful place in any list. *Carpinifolia* Bdv. is also given as a synonym of *americana*, and Mr. Kirby thus goes further than any American author has yet done to my knowledge. To *Gloveria* are referred the species of our list and some Mexican forms. Genus 100 is *Heteropacha*, with *rileyana* as sole species and type. Under *Clisiocampa* no change has been made in our species. *Artace* has *punctistriga* as type, *rubripalpis* Feld. as variety, and *albicans* as other American species. By an error of date I was induced to give Felder's name priority in my list; it must be as Mr. Kirby has it. Our species of *Tolype* are unchanged. *Apatelodes* appears in this family quite out of place; and finally we have *Acronyctodes insignata* Hy. Edw. credited to Arizona. It was described from Mexico.

The Pinaridæ is a small family which is not represented in our fauna.

Family XXVIII is the Zeuzeridæ, Mr. Kirby rejecting the term *Cossus* in favor of *Trypanus* Ramb., because *Cossus* had been previously used as a specific term. It is perhaps questionable whether this will be followed by lepidopterists generally. *Quadrina diazoma* heads the family, and *Trypanus* (*Cossus*) is genus 4. All the species of our list are found here, but some changes are introduced. *Cossus macmurtrici* Peale is written *macmurtrei* Guer., dating 1829. Peale is not cited, but I believe that 1857 is the date of his *opus;* which determination is correct, I do not know.

*C. undosus* Lint. is wrongly written *nodosus*. *Nanus* Strck. is re-

ferred to *Prionoxystus*. In *Hypopta* we find our species unchanged. *Prionoxystus* contains our species and *piger* from Cuba. *Cossula basalis* appears in genus 21, in the full glory of its synonymy, generic and specific. Under *Zeuzera* we find *canadensis* H.-S. and *decipiens* Kirby. The latter name has as synonym *Hepialus pyrinus* Fab., *Zeuzera pyrina* Wlk. and Machesney. Mr. Kirby seems to consider that our species is not the same as the European form, and therefore names it, giving N. America as the habitat. I believe that Mr. Kirby is mistaken. The insect has been carefully compared with European specimens by competent entomologists and has been declared identical with them. It is still so limited in distribution, and its history since its appearance here is so well known, that its recent introduction is a matter scarcely questionable. It would be interesting to have Mr. Kirby point out the differences between the species. It is curious that *Z. canadensis* should not have been rediscovered by the many good Canadian collectors, and it raises a suspicion that the locality may have been erroneously given.

Family XXIX is the Hepialidæ, and the last of the series. The typical genus heads the list, and contains a large proportion of our species. *Carnus* is not credited to our fauna, and Walker's identification of the species from Hudson's Bay Territory may easily have been incorrect. All the varieties in my list, save *montanus* Stretch, are here given specific rank. *Argenteomaculatus*, *argentatus*, *quadriguttatus*, *purpurascens* and *thule*, are referred to *Sthenopis*, and in the other genera no species from our fauna appear.

In its entirety Mr. Kirby's work is worthy of the highest praise. I have noted no important omissions and very few errors of any kind. Mr. Kirby shows a remarkable acquaintance with entomological literature—an acquaintance in which no one who has not access to the vast wealth of the London libraries can hope to rival him. To the working entomologist the work is indispensable, and a very godsend. In typography and general get up, it leaves little to be desired. Mr. Kirby has apparently been at great pains to fix the types of genera, and in most cases his conclusions will have to be accepted. In the adoption of the Tentamen names I must decline to follow him; but I have long felt that many of the Verzeichniss names must come to be used in time. A serious fault in the work is, that it is not possible to learn from it what synonymy is original and what is adopted. As a guide to distribution, it is useless, except in the most limited way. No pretence to completeness

of bibliography is made, but a reference to faunal monographs of families or groups would have added greatly to the value of the work and would not have taken much more space. As authority for specific rank it must be very cautiously used, in our fauna at least. With the family groupings, or rather the grouping of genera into families I disagree entirely. No series of insects affords better opportunities for family divisions on structural characters than do the Bombyces, and, to our shame be it said, in no series is the classification so utterly superficial, so completely at variance with all scientific bases than just here where the work is easiest. I do not believe that more than half a dozen of the twenty-nine families accepted are capable of clean scientific definition. This is not Mr. Kirby's fault of course; it is, however, disappointing that the catalogue not only makes no advance in the matter of classification, but does not even accept sharply limited groups where they have been so well defined that recognition is easy. I realize, of course, that Mr. Kirby could not in all cases make even a good guess at the real location of some of the described forms; but this does not affect the criticism made, since the bad associations occur also among forms well represented in the British Museum.

To bring out somewhat more sharply the contrast between Mr. Kirby's work and the arrangement adopted in my recent list, which embodies the results attained by American students, I give in serial form the species credited to our fauna as they stand in the catalogue; while to show, in a measure, the proportion of our own forms to those of the world, I retain Mr. Kirby's numbering to families, genera and species.

### Family I. CASTNIIDÆ.

Genus MEGATHYMUS Scudd.

1. yuccæ* Bdv. Lec.
2. cofaqui Strk.
3. neumoegeni Hy. Edw.

### Family II. COCYTIIDÆ.

Not represented.

### Family III. URANIIDÆ.

Not represented.

### Family IV. AGARISTIDÆ.

Genus 17. PSEUDALYPIA Hy. Edw.

1. crotchii* Hy. Edw.
   var. *atrata* Hy. Edw.

Genus 18. ALYPIODES Grt.

1. crescens* Wlk.
   *Alypia grotei* Bdv.
   *Alypiodes flavilinguis* Grt.

Genus 19. ANDROLOMA Grt.

1. lorquinii* G. & R.
2. maccullochii Kirby.

* Indicates that the species is the type of the genus.

3. ridingsii Grt.
4. similis Stretch.
   *edwardsii* Bdv.
   var. *conjuncta* Hy. Edw.
5. brannani Stretch.

Genus 20. **ALYPIA** Hüb.

1. octomaculata Fab.
   *quadriguttalis* Hüb.
   *Zygæna bimaculata* Gmel.
   *matuta* Hy. Edw.
3. albomaculata Stoll.
   *octomaculalis* Hüb.
   *Agarista octomaculata* Latr.
4. wittfieldi Hy. Edw.
5. langtonii Coup.
6. hudsonica Hy. Edw.
7. mariposa Grt. & Rob.
   var. *lunata* Stretch.
8. dipsaci Grt. & Rob.
9. sacramenti Grt. & Rob.

Genus 22. **PSYCHOMORPHA** Harr.

1. epimenis* Dru.

Genus 23. **EUEDWARDSIA** Grt.

1. brillians* Neum.

Genus 27. **COPIDRYAS** Grt.

1. gloveri* Grt. & Rob.

Genus 28. **FENARIA** Grt.

1. sevorsa* Grt.

Genus 29. **EUTHISANOTIA** Hüb.

1. unio* Hüb.
2. grata Fab.
   *assimilis* Bdv.
3. brevipennis Stretch.
5. sanctæ Johannis Wlk.

Genus 30. **CIRIS** Grt.

1. wilsonii* Grt.

Genus 35. **METAGARISTA** Wlk.

3. sabulosa Bdv.

## Family V. CHALCOSIIDÆ.

Not represented.

## Family VI. THYMARIDÆ.

Not represented.

## Family VII. ZYGÆNIDÆ.

### Subfamily 1. ANTHROCERINÆ.

Not represented.

### Subfam. 2. ADSCITINÆ.

Genus 9. **TANTURA** Kirby.

1. majuscula* Hy. Edw.
2. parvula Hy. Edw.

### Subfam. 3. ZYGÆNINÆ.

Not represented.

### Subfam. 4. THYRETINÆ.

Not represented.

### Subfam. 4. PHAUDINÆ.

Not represented.

### Subfam. 5. PYROMORPHINÆ.

Genus 66. **ACOLOITHUS** Clem.

1. falsarius* Clem.
   *sanborni* Pack.

Genus 67. **HARRISINA** Pack.

1. coracina Clem.
2. texana Stretch.
3. americana* Guér.
4. australis Stretch.
5. metallica Stretch.
9. nigrina Graef.

Genus 68. **TRIPROCRIS** Grt.

1. smithsonianus* Clem.
2. martenii French.
3. aversus Hy. Edw.

Genus 72. **PYROMORPHA** H.-S.

1. dimidiata* H.-S.
   *perlucida* Clem.
3. fusca Hy. Edw.

Genus 73. **LYCOMORPHA** Harr.

1. pholus Dru.
3. desertus Hy. Edw.

* Indicates that the species is the type of the genus.

4. centralis Wlk.
6. constans Hy. Edw.
7. rata Hy. Edw.
10. latercula Hy. Edw.
12. palmeri Pack.
13. miniata Pack.
14. coccinea Hy. Edw.

Genus 74. ANATOLMIS Pack.

1. grotei* Pack.
2. fulgens Hy. Edw.

### Subfam. 7. Euchromiinæ.

Genus 82. SYNTOMEIDA Harr.

12. ipomeæ Harr.*
*ferox* Wlk.
*euterpe* H.-Sch.

Genus 83. DAHANA Grt.

1. atripennis* Grt.

Genus 97. PHYLLŒCIA Guér.

5. texanus Grt.
*plumipes* Wlk.

Genus 105. ERRUCA Wlk.

1. pertyi H.-Sch.

Genus 110. DIDASYS Grt.

1. belæ Grt.*

Genus 123. COSMOSOMA Hüb.

24. auge* L.
*omphale* Hüb.

### Subfam. 8. Trichurinæ.

Not represented.

### Subfam. 9. Antichlorinæ.

Not represented.

## Family VIII. ARCTIIDÆ.

### Subfam. 1. Charidiinæ.

Genus 29. NELPHE H.-Sch.

6. carolina Hy. Edw.

Genus 37. SCEPSIS Wlk.

1. gravis Hy. Edw.
4. fulvicollis* Hüb.
*semidiaphana* Harr.
*packardii* Grt.
var. pallens Hy. Edw.
5. matthewi Hy. Edw.
6. wrightii Stretch.
7. edwardsii Grt.

### Subfam. 2. Ctenuchinæ.

Genus 40. CTENUCHA Kirby.

1. virginica* Charp.
*latreillana* Kirby.

Genus 41. COMPSOBRIUM Blanch.

1. cressonanum Grt.

Genus 42. EUCTENUCHA Grt.

1. ochroscapus Grt. & Rob.
*corvina* Edv.
2. multifaria* Wlk.
*rubroscapus* || Bdv.
3. rubroscapus Men.
*walsinghami* Hy. Edw.
4. brunnea Stretch.
5. sanguinaria Streck.

Genus 43. PYGOCTENUCHA Grt.

1. robinsonii Bdv.
2. harrisii* Bdv.
*pyrrhoura* Hulst.
7. funerea Grt.

### Subfam. 3. Pericopinæ.

Genus 51. GNOPHÆLA Wlk.

1. vermiculata Grt. & Rob.
*æquinoctialis* || Bdv.
var. continua Hy. Edw.
3. discreta Stretch.
*arizonæ* French.
*morrisoni* Druce.
4. latipennis Bdv.
*hopfferi* Grt. & Rob.
6. clappiana Holl.

* Indicates that the species is the type of the genus.

## Subfam. 4. PHÆGOPTERINÆ.

Genus 88. **ALEXICLES** Grt.

1. aspersa* Grt.

Genus 91. **THEAGES** Wlk.

3. ? laqueata Hy. Edw.

Genus 105. **EUPSEUDOSOMA** Grt.

2. floridum Grt.

Genus 113. **LOPHOCAMPA** Harr.

4. agassizii Pack.
   *californica* Wlk.
   *angulifera* Wlk.
   *salicis* Bdv.
   var. alni Hy. Edw.
5. maculata Harr.
   *fulvoflava* Wlk.
   *guttifera* H.-Sch.
6. caryæ* Harr.
   *annulifascia* Wlk.
   *porphyria* H.-Sch.
16. argentata Pack.
18. sobrina Stretch.
19. scapularis Stretch.
20. ingens Hy. Edw.
21. occidentalis French.
22. subalpina French.

Genus 114. **EUHALISIDOTA** Grt.

5. longa Grt.
6. pura Neum.

Genus 115. **HALISIDOTA** Hüb.

2. davisii Hy. Edw.
5. labecula Grt.
6. edwardsii Pack.
   *translucida* Wlk.
   *quercus* Bdv.
8. tessellaris* A. & S.
   *antiphola* Walsh.
   *harrisii* Walsh.
12. mixta Neum.
25. minima Neum.
33. trigona Grt.
43. cinnamomea Bdv.
46. significans Hy. Edw.
49. ambigua Stretch [Strck.].
   *bolteri* Hy. Edw.

Genus 119. **ECPANTHERIA** Hüb.

13. sennettii Lint.
37. cæca Strck.
39. ocularia* Fab.
   *scribonia* Stoll.
   *oculatissima* S. & A.
   *chryseis* Oliv.
   *cunegunda* Beauv.
   ab. confluens Oberth.
   var. denudata Sloss.
53. reducta Grt.

Genus 121. **ÆMELIA** Kirby.

1. roseata Wlk.

Genus 122. **ARACHNIS** Geyer.

2. picta Pack.
7. zuni Schaus.

## Subfam. 5. SPILOSOMATINÆ.

Genus 140. **ANTARCTIA** Hüb.

12. beanii Neum.
   var. fuscosa Neum.

Genus 142. **ESTIGMENE** Hüb.

1. acræa Dru.
   var. caprotina Dru.
   *pseuderminea* Harr.
   *californica* Pack.
   *packardii* Schaupp.
   *menthastrina* Mart.
3. permaculata Pack.
   *nigroflava* Graef.
4. albida Stretch.
5. dubia Wlk.
6. niobe Strck.

Genus 143. **SPILOSOMA** Steph.

7. virginica Fab.
8. prima Sloss.
10. latipenne Stretch.
11. vestalis Pack.
12. antigone Strck.

Genus 151. **HYPHANTRIA** Harr.

1. cunea Dru.
   *punctatissima* A. & S.
2. textor* Harr.
   *candida* Wlk.
3. punctata Fitch.

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* Indicates that the species is the type of the genus.

Genus 152. ECTYPIA Clem.

1. bivittata* Clem.

Genus 153. ENERYTHRA Harr.

1. trimaculata Smith.
2. phasma* Harv.

Genus 157. CYCNIA Hüb.

1. egle Dru.
2. eglenensis Clem.
4. murina Stretch.
5. immaculata Graef.
6. abdominalis Grt.
7. spraguei Grt.
8. bolteri Stretch.
9. elegans Stretch.
12. zonalis Grt.
13. vivida Grt.
14. perlevis Grt.
16. inopinatus Hy. Edw.
18. oregonensis Stretch.
19. collaris Fitch.
    *antica* Wlk.
    *sciurus* Bdv.
20. pudens Hy. Edw.
21. tenera* Hüb.
22. scepsiformis Graef.
23. budea Hüb.
24. yosemite Hy. Edw.

Genus 158. PAREUCHÆTES Grt.

3. conspicua Neum.

Genus 160. VANESSODES G. & R.

1. clarus* G. & R.
2. fuscipes Grt.

Genus 174. SEIRARCTIA Pack.

1. echo* A. & S.
2. clio Pack.

Genus 177. PYRRHARCTIA Pack.

1. isabella* A. & S.
    *californica* Pack.

Subfam. 6. ARCTIINÆ.

Genus 178. CODIOSOMA Stretch.

1. fulva* Stretch.
2. nigra Stretch.
3. tricolor Stretch.
4. eavesii Stretch.

Genus 179. PHRAGMATOBIA Steph.

4. rubricosa Harr.
    *assimilans* Wlk.
    var. franconia Sloss.
    *rubicundaria* Clem.
12. vagans Bdv.
    *pteridis* Hy. Edw.
    *rufula* Bdv.
    *punctata* Pack.
    var. proba Hy. Edw.
15. rubra Neum.
16. walsinghami Butl.

Genus 190. PARASEMIA Hüb.

3. petrosa Wlk.
    var. cespites Grt. & Rob.
    var. cichorii Grt. & Rob.
4. geometrica Grt.
5. geddesi Neum.
6. selwynii Hy. Edw.
7. modesta Pack.
8. scudderii Pack.

Genus 191. HAPLOA Hüb.

1. conscita Wlk.
    *lactata* Smith.
2. vestalis Pack.
3. fulvicosta Clem.
4. carolina Harr.
5. clymene Brown.
    *interruptomarginata* Beauv.
    *comma* Wlk.
6. contigua Wlk.
7. colona Hüb.
    *clymene* Esp.
8. reversa Stretch.
9. suffusa Smith.
10. lecontei Guer.
    *leucomelas* H.-Sch.
11. militaris Harr.
12. confinis Wlk.
13. confusa Lym.

Genus 196. CALLIMORPHA Latr.

11. virginalis Bdv.
    var. ochracea Stretch.
    var. guttata H.-Sch.

* Indicates that the species is the type of the genus.

Genus 200. PLATARCTIA Pack.

1. parthenos* Harr.
   *americana* Wlk.
2. borealis Moeschl.
6. yarrowi Stretch.
7. remissa Hy. Edw.

Genus 202. HYPERCOMPA Hüb.

1. caia* Linn.
   var. americana Harr.
   var. utahensis Hy. Edw.
6. opulenta Hy. Edw.

Genus 207. HYPHORAIA Hüb.

5. hyperborea Curt.

Genus 213. APANTESIS Wlk.

1. virgo Linn.
2. parthenice Kirby.
3. nerea Bdv.
4. michaba Grt.
5. doris Bdv.
6. arge Dru.
   *dione* Fab.
   *cœlebs* Mart.
   *incarnatorubra* Goeze.
7. achaia Grt. & Rob.
   var. ochracea Stretch.
   var. barda Hy. Edw.
8. stretchi Grt.
9. shastaensis French.
10. intermedia Stretch.
11. simplicior Butl.
12. saundersii Grt.
13. approximata Stretch.
14 persephone Grt.
15. anna Grt.
16. blakei Grt.
17. rectilinea French.
18. phyllira Dru.
   *B-ata* Goeze.
   *plantaginis* Mart.
   var. lugubris Hulst.
19. bolanderi Stretch.
20. nevadensis Grt. & Rob.
   var. incorrupta Hy. Edw.
   var. sulphurica Neum.
   var. mormonica Neum.
   var. behri Stretch.
21. superba Stretch.
22. geneura Streck.
23. dodgei Butl.
24. williamsi Dodge.
25. edwardsii Stretch.
26. rhoda Butl.
27. determinata Neum.
28. pallida Neum.
29. bimaculata Saund.
30. nais* Dru.
   *cuneata* Goeze.
   *defloriana* Mart.
   ♄ *phalerata* Harr.
   var. vittata Fab.
   *radians* Wlk.
   *colorata* Wlk.
   *decorata* Saund.
   var. incompleta Butl.
31. franconia Slosson.
32. figurata Dru.
   *ceramica* Hüb.
   *celia* Saund.
33. quadrinotata Strck.
34. snowi Grt.
35. ochreata Butl.
36. placentia A. & S.
37. flammea Neum.
38. pallida Pack.
39. excelsa Neum.
43. virguncula Kirby.
   var. complicata Wlk.
   *dahurica* Grt.
44. oithona Strck.
45. elongata Stretch.
46. dieckii Neum.
47. brucei Hy. Edw.

Genus 215. ORODEMNIAS Wallengr.

1. quenselii* Payk.
   *strigosa* Fab.
   var. gelida Moeschl.
3. speciosa Moeschl.
4 obliterata Stretch.
6. cervinoides Strck.

Genus 216. CALLARCTIA Pack

3. ornata* Pack.
5. favorita Neum.
6. arizonensis Stretch.

* Indicates that the species is the type of the genus.

Genus 222. LEPTARCTIA Stretch.

1. stretchii Butl.
2. dimidiata Stretch.
3. boisduvali Butl.
4. albifascia French.
5. occidentalis French.
6. latifasciata Butl.
7. fulvofasciata Butl.
8. californiæ* Wlk.
   *adnata* Bdv.
9. wrightii French.
10. decia Bdv.
11. lena French.

## Family IX. CYMBIDÆ.

Genus 6. EARIAS Hüb.

25. obliquata Hy. Edw.

## Family X. LITHOSIIDÆ.

Genus 11. HYPOPREPIA Hüb.

1. fucosa* Hüb.
   *miniata* Kirby.
   *vittata* Harr.
2. plumbea Hy. Edw.
3. cadaverosa Strck.
4. inculta Hy. Edw.

Genus 12. CISTHENE Wlk.

4. unifascia Grt. & Rob.
5. tenuifascia Harr.
6. packardii Grt.
7. subjecta* Wlk.
9. plumbea Stretch.
16. lactea Stretch.

Genus 13. PYRALIDIA Feld.

2. faustinula Bdv.
   var. fusca Stretch.
3. nexa Bdv.
   *grisea* Pack.
4. deserta* Feld.

Genus 14. HYALOSCOTES Butl.

1. fumosa* Butl.

Genus 92. LITHOSIA Fab.

37. argillacea Pack.
   *bicolor* Grt.
55. rubropicta Pack.

Genus 122. CRAMBIDIA Pack.

1. pallida* Pack.
5. candida Hy. Edw.
6. casta Pack.
7. cephalica Grt. & Rob.

Genus 126. EUSTIXIA Hüb.

1. pupula* Hüb.

Genus 144. COSCINIA Hüb.

6. ampla Grt.

Genus 147. UTETHEISA Hüb.

2. ornatrix Linn.
   var. hybrida Butl.
3. bella Linn.
   var. intermedia Butl.

Genus 163. EUBAPHE Hüb.

1. diminutiva Graef.
2. belfragei Stretch.
3. costata Stretch.
5. aurantiaca* Hüb.
   *rubicundaria* Hüb.
6. brevicornis Wlk.
7. ferruginosa Wlk.
8. obscura Stretch.
   *ferruginosa* Pack.
9. quinaria Grt.
   *choriona* Reak.
10. nigricans Reak.
14. opella Grt.
   *rubicundaria* Wlk.
15. opelloides Graef.
18. læta Guer.
19. rubropicta Pack.
20. ostenta Hy. Edw.
21. intermedia Graef.
22. treatii Grt.
23. fragilis Strck.
24. rosa French.

Genus 166. EUDULE Hüb.

1. texana French.
2. unicolor Rob.
3. immaculata Reak.
   var. trimaculata Reak.

* Indicates that the species is the type of the genus.

Genus 179. PAGARA Wlk.

1. simplex* Wlk.
   *murina* Wlk.

Genus 182. EUPHANESSA Pack.

1. mendica* Wlk.
   *biseriata* H.-Sch.
2. meridiana Sloss.

Genus 190. CLEMENSIA Pack.

1. albata* Pack.
   *albida* Wlk.
   *cana* Wlk.
2. umbrata Pack.
3. irrorata Hy. Edw.

Genus 195. NYCTEOLA Hüb.

9. lintnerana Spey.
10. columbiana Hy. Edw.

Genus 199. EULITHOSIA Hy. Edw.

1. composita* Hy. Edw.
2. thoracica Hy. Edw.

Genus 201. NOLA Leach.

5. minuscula Zell.
   *fuscula* Grt.
14. anfracta Hy. Edw.
34. ovilla Grt.
40. hyemalis Stretch.

Genus 205. ARGYROPHYES Grt.

1. pustulata Wlk.
   *nigrofasciata* Zell.
   *obaurata* Morr.
2. ciliaoides* Grt.

Genus 210. LEBENA Wlk.

1. trinotata* Wlk.
   *sexmaculata* Grt.
2. minna Butl.
4. sorghiella Riley.
8. melanopa Zell.

## Family XI. HYPSIDÆ.

Not represented.

## Fam. XII. CALLIDULIDÆ.

Not represented.

## Fam. XIII. CYLLOPODIDÆ.

Not represented.

## Fam. XIV. DIOPTIDÆ.

Genus 3. PHRYGANIDIA Pack.

1. californica* Pack.

Genus 4. DIOPTIS Hüb.

18. megæra Fab.

## Fam. XV. NYCTEMERIDÆ.

Not represented.

## Fam. XVI. LIPARIDÆ.

Genus 9. CINGILIA Wlk.

1. humeralis* Wlk.

Genus 22. CARAMA Wlk.

10. cretata Grt.

Genus 61. ARTAXA Wlk.

54. (?) ingenita Hy. Edw.

Genus 110. PARORGYIA Pack

1. leucophæa A. & S.
4. clintonii Grt. & Rob.
5. achatnia* A. & S.
6. parallela Grt. & Rob.
7. obliquata Grt. & Rob.
8. cinnamomea Grt. & Rob.
9. basiflava Pack.

Genus 113. LAGOA Harr.

1. pyxidifera A. & S.
2. opercularis A. & S.
   *lanuginosa* Clem.
3. crispata Pack.

Genus 135. DASYCHIRA Hüb.

8. rossii Curt.
9. groenlandica Hom.
10. lintneri Grt.

Genus 143. CALOCASIA Ochs

2. diversicolor Morr.
3. flavicornis Smith.

Genus 147. NERICE Wlk.

1. bidentata* Wlk.

* Indicates that the species is the type of the genus.

Genus 154. COTHOCIDA Wlk.

1. nigrifera* Wlk.

Genus 164. NOTOLOPHUS Germ.

17. antiquus* Linn.
*nova* Fitch.
*badia* Hy. Edw.
31. definitus Pack.
32. vetustus Bdv.
33. gulosus Hy. Edw.
34. canus Hy. Edw.
35. leucostigma A. & S.
36. leucographus Geyer.
var. olivacea Hy. Edw.
61. inornatus Beut.

## F. XVII. HETEROGYNIDÆ

Not represented.

## Fam. XVIII. PSYCHIDÆ.

Genus 2. OIKETICUS Guild.

1. abbottii Grt.
2. davidsoni Hy. Edw.

Genus 3. THYRIDOPTERYX Steph.

1. ephemeræformis* Haw.
*plumifera* Steph.
*coniferarum* Pack.
2. meadii Hy. Edw.

Genus 8. MANATHA Moore.

2. edwardsii Heyl.

Genus 25. CHALIA Moore.

14. rileyi Heyl.

Genus 32. PSYCHE Schrank.

12. confederata Grt. & Rob.
13. carbonaria Pack.
14. coniferella Hy. Edw.
15. fragmentella Hy. Edw.

Genus 33. PLATŒCETICUS Pack.

1. gloverii* Pack.

Genus 44. ŒDONIA Kirby.

1. exigua* Hy. Edw.

Genus 45. SAPINELLA Kirby.

1. mora* Grt.

## Fam. XIX. LIMACODIDÆ.

Genus 33. SEMYRA Wlk.

4. beutenmuelleri Hy. Edw.

Genus 36. PHOBETRUM Hüb.

1. pithecium* A. & S.
*abbotana* Hüb.
2. hyalinum Walsh.
3. nigricans Pack.
4. tetradactylus Walsh.

Genus 37. ADONETA Clem.

1. spinuloides* H.-Sch.
*voluta* Clem.
2. leucosigma Pack.
3. pygmæa Grt.

Genus 38. EULIMACODES Moeschl.

1. scapha Harr.
*undifera* Wlk.

Genus 52. NOCHELIA Clem.

1. tardigrada* Clem.

Genus 53. EMPRETIA Clem.

1. stimulea* Clem.

Genus 54. SIBINE H.-Sch.

11. (?) ephippiatus Harr.

Genus 67. PARASA Moore.

49. chloris H.-Sch.
*fraterna* Grt.
50. viridus Reak.
*vernata* Pack.

Genus 68. VARINA Neum.

1. ornata* Neum.

Genus 69. EUCLEA Hüb.

2. viridiclava Wlk.
3. querceti H.-Sch.
*cippus* A. & S.
var. delphinii Bdv.
var. interjecta Dyar.
var. monitor Pack.
4. quercicola H.-Sch.
5. bifida Pack.
6. ferruginea Pack.

* Indicates that the species is the type of the genus.

7. punctulata Clem.
9. incisa Harv.
10. elliotii Pears.
17. nana Dyar.

Genus 70. MONOLEUCA Grt. & Rob.

1. semifascia* Wlk.
2. sulphurea Grt.
3. obliqua Hy. Edw.
4. subdentosa Dyar.

Genus 78. SOSIOSA Kirby.

1. textula* H.-Sch.

Genus 79. TORTRICIDIA Pack.

1. flavula H.-Sch.
2. pallida H.-Sch.
3. testacea* Pack.
4. ferrigera Wlk.

Genus 82. KRONEA Reak.

1. minuta* Reak.

Genus 83. APODA Haw.

7. trigona Hy. Edw.
8. tetraspilaris Wlk.
9. biguttata Pack.
10. Y-inversa Pack.
11. parallela Hy. Edw.

Genus 88. SICYROSEA Grt.

1. inornata Grt. & Rob.
2. nasoni Grt.
3. rude Hy. Edw.

Genus 89. PACKARDIA Grt. & Rob.

1. elegans* Pack.
2. fusca Pack.
3. geminata Pack.
4. albipunctata Pack.
5. ocellata Grt.
6. nigropunctata Good.
7. goodellii Grt.

Genus 91. LITHACODES Pack.

1. fasciola* H.-Sch.
2. laticlavia Clem.
3. flexuosa Grt.
4. cæsonia Grt.
5. rectilinea Grt. & Rob.
   *latomia* Harv.
6. graefii Pack.

Genus 94. HETEROGENEA Knoch.

5. shurtleffi Pack.

## Fam. XX. NOTODONTIDÆ.

Genus 12. LITODONTA Harv.

1. hydromeli* Haw.

Genus 13. HETEROCAMPA Doubl.

2. athereo Harr.
3. astarte* Doub.
   *menas* Harr.
   *varia* Wlk.
4. obliqua Pack.
   var. brunnea Grt. & Rob.
5. lunata Hy. Edw.
7. trouvelotii Pack.
8. subrotata Harv.
9. celtiphaga Harv.
11. pulverea Grt. & Rob.
13. marthesia Cram.
   *tessella* Pack.
   *turbida* Wlk.
15. elongata Grt. & Rob.
16. guttivitta Wlk.
   *albiplaga* Wlk.
   *indeterminata* Wlk.
   *mucorea* H.-Sch.
20. chapmani Grt.
25. biundata Wlk.
   *olivatus* Pack.
26. viridescens Wlk.
27. umbrata Wlk.
28. cinerea Pack.
   *sobria* Wlk.
29. unicolor Pack.
30. marina Pack.
31. manteo Doubl.
   *cinerascens* Wlk.
   *subalbicans* Grt.
32. doubledayi Scudd.
34. belfragei Grt.
35. thyatiroides Wlk.
36. significata Wlk.
37. nigrosignata Wlk.

* Indicates that the species is the type of the genus.

38. mollis Wlk.
39. superba Hy. Edw.
53. nivea Neum.

Genus 21. ŒDEMASIA Pack.

1. concinna* A. & S.
2. semirufescens Wlk.
3. eximia Grt.
4. nitida Pack.
5. badia Pack.
6. salicis Hy. Edw.
7. riversii Behr.
8. perangulata Hy. Edw.

Genus 23. SCHIZURA Doubl.

1. unicornis A. & S.
2. humilis Wlk.
3. conspecta Hy. Edw.
4. edmandsii Pack.
5. apicalis Grt. & Rob.
6. leptinoides Grt.
7. mustelina Pack.
8. ipomeæ* Doubl.
   *biguttatus* Pack.
   *ducens* Wlk.
   *corticea* Wlk.
   *compta* Wlk.
   *confusa* Wlk.
   var. cinereofrons Pack.
   *ustipennis* Wlk.
9. telifer Grt.
10. harrisii Pack.

Genus 25. SALIGENA Wlk.

1. personata* Wlk.

Genus 26. SEIRODONTA Grt.

1. bilineata* Pack.
   *associata* Wlk.
   *ulmi* Harr.

Genus 27. HATIMA Wlk.

1. semirufescens* Wlk.
2. anguina A. & S.
   *cucullifera* H.-Sch.
   *punctata* Wlk.
   *cana* Wlk.
3. interna Pack.
   *tripartita* Wlk.

Genus 30. IANASSA Wlk.

1. lignicolor* Wlk.
   *virgata* Pack.
   *lignigera* Wlk.
   *transversata* Wlk.
   var. coloradensis Hy. Edw.

Genus 34. SYMMERISTA Hüb.

1. albicosta* Hüb.

Genus 40. EDEMA Wlk.

2. albifrons* A. & S.
4. packardii Morr.
6. (?) obliqua Wlk.
7. (?) plagiata Wlk.

Genus 41. STRETCHIA Hy. Edw.

1. plusiiformis* Hy. Edw.

Genus 42. ACHERDES Wlk.

1. ferraria* Wlk.

Genus 80. CERTILA Wlk.

1. flexuosa* Wlk.

Genus 82. HYPARPAX Hüb.

1. aurora* A. & S.
   *venusta* Wlk.
   *rosea* Wlk.
2. aurostriata Graef.

Genus 83. PSAPHIDIA Wlk

1. resumens* Wlk.

Genus 84. CERURA Schrank.

15. scolopendrina Bdv.
16. cinerea Wlk.
17. cinereoides Dyar.
18. scitiscripta Wlk.
19. borealis Guér.
   *furcula* A. & S.
20. albicoma Strck.
21. candida Lintn.
22. occidentalis Lintn.
   *borealis* Harr.
23. aquilonaris Lintn.
25. multiscripta Riley.
38. modesta Hudson.

* Indicates that the species is the type of the genus.

Genus 89. PANTHEA Hüb.

3. leucomelæna Morr.

Genus 93. THAUMETOPŒA Hüb.

10. grisea Neum.

Genus 96. GLUPHISIA Bdv.

3. septentrionis Wlk.
4. trilineata Pack.
5. (?) tearlii Hy. Edw.
6. (?) wrightii Hy. Edw.
7. (?) severa Hy. Edw.
8. ridenda Hy. Edw.
9. rupta Hy. Edw.
10. albofascia Hy. Edw.
11. formosa Hy. Edw.
12. avimacula Hudson.

Genus 117. ELLIDA Grt.

1. gelida* Grt.

Genus 122. NOTODONTA Ochs.

23. stragula Grt.
24. basitriens Grt.
25. simplaria Graef.
26. plagiata Wlk.
27. notaria Hy. Edw.

Genus 125. LOPHODONTA Pack.

1. angulosa A. & S.
2. georgica H.-Sch.
3. ferruginea Pack.
4. plumosa Hy. Edw.

Genus 129. OCHROSTIGMA Hüb.

4. tortuosa Tepp.

Genus 137. LOPHOPTERYX Steph.

14. americana Haw.
15. elegans Strck.
    var. orissa Strck.

Genus 142. PHEOSIA Hüb.

10. rimosa Pack.
11. portlandia Hy. Edw.
12. dimidiata H.-Sch.
13. californica Stretch.

Genus 146. MELALOPHA Hüb.

7. apicalis Wlk.
8. inclusa Hüb.
    *anastemosis* S. & A.
    *americana* Harr.
9. incarcerata Bdv.
10. jocosa Hy. Edw.
11. strigosa Grt.
12. luculenta Hy. Edw.
13. ornata Grt. & Rob.
14. inornata Neum.
15. astoriæ Hy. Edw.
16. palla French.
17. inversa Pack.
18. indentata Pack.
19. albosigna Fitch.
20. vau Fitch.
21. brucei Hy. Edw.
22. bifiria Hy. Edw.

Genus 153. DATANA Wlk.

Unchanged. Contains our species only.

Genus 155. NADATA Wlk.

1. doubledayi Pack.
    var. oregonensis Butl.
2. gibbosa* A. & S.
3. behrensii Hy. Edw.

## Fam. XXI. SPHINGIDÆ.

### Subfam. 1. MACROGLOSSINÆ.

Genus 1. HEMARIS Dalm.

1. fuscicaudis Wlk.
2. floridensis Grt. & Rob.
3. thysbe Fab.
    *pelasgus* Cram.
    *cimbiciformis* Steph.
    *etolus* Bdv.
4. ruficaudis Kirby.
5. buffaloensis Grt. & Rob.
6. uniformis Grt. & Rob.
7. pyramus Bdv.
8. gracilis Grt. & Rob.
12. axillaris Grt. & Rob.
    *grotei* Butl.
13. marginalis Grt.
21. diffinis Bdv.
    *fusiformis* A. & S.
22. æthra Strck.

* Indicates that the species is the type of the genus.

23. palpalis Grt.
24. tenuis Grt.
    *fumosa* Strck.
25. thetis Grt. & Rob.
26. metathetis Butl.
27. rubens Hy. Edw.
28. senta Strck.
29. brucei French.
30. cynoglossum Hy. Edw.

Genus 3. LEPISESIA Grt.

1. flavofasciata* Wlk.
2. ulalume Strck.

Genus 11. EUPROSERPINUS G. & R.

1. phæton* Grt. & Rob.
    *errato* Bdv.
2. euterpe Hy. Edw.

Genus 12. DIENECES Butl.

1. clarkiae* Bdv.
    *victoria* Grt.
2. circæ Hy. Edw.

Genus 14. PERIGONIA H.-Sch.

10. tacita Druce.

Genus 17. SPHECODINA Blanch.

1. abbotii* Swains.

Genus 18. AMPHION Hüb.

1. nessus* Cram.

Genus 19. DEIDAMIA Clem

1. inscriptum* Harr.

Genus 21. PTEROGON Bdv.

3. gauræ A. & S.
4. juanita Strck.
5. terlooi Hy. Edw.

## Subfam. 2. Chœrocampinæ.

Genus 40. THERETRA Hüb.

81. tersa Linn.
88. procne Clem.

Genus 46. DEILEPHILA Ochs.

2. lineata Fab.
    *daucus* Cram.
6. galii Rott.
    var. intermedia Kirby.
    *chamænerii* Harv.
7. oxybaphi Clem.

Genus 47. DUPO Hüb.

1. vitis* Linn.
    *fasciatus* Sulz.
    *jussieuæ* Hüb.
2. linnei Grt. & Rob.
    *vitis* Stoll.

Genus 48. PHILAMPELUS Harv.

3. pandorus* Hüb.
    *ampelophaga* Harr.
    *satellitia* Dru.
6. satellitia Linn.

Genus 49. PHOLUS Hüb.

1. achemon* Dru.
    *crantor* Cram.

Genus 52. DARAPSA Wlk.

5. versicolor Harr.

Genus 55. EVERYX Ménétr.

1. chœrilus Cram.
    *azaleæ* S. & A.
    *chlorinda* Mart.
3. myron Cram.
    *pampinatrix* A. & S.
    var. cnotus Hüb.

## Subfam. 3. Ambulicinæ.

Genus 61. PACHYLIA Wlk.

1. lyncea Clem.

## Subfam. 4. Sphinginæ.

Genus 65. DILUDIA Grt. & Rob.

1. brontes Dru.

Genus 67. DAREMMA Wlk.

1. undulosa* Wlk.
    *brontes* Bdv.
2. hageni Grt.
3. catalpæ Bdv.

* Indicates that the species is the type of the genus.

Genus 69. DOLBA Wlk.

1. hylæus* Dru.
   *prini* A. & S.

Genus 76. PHLEGETHONTIUS Hüb.

1. rustica Fab.
   *chionanthi* A. & S.
2. dalica Kirby.
13. sexta* Joh.
   *carolina* Linn.
14. lycopersici Bdv.
15. dilucida Hy. Edw.
16. quinquemaculata Haw.
   *carolina* Don.
   *celeus* Hüb.
35. cingulata Fab.
   *convolvuli* Dru.
   *affinis* Goeze.
   *druræi* Don.
   *pungens* Esch.
   var. decolora Hy. Edw.

Genus 77. SPHINX Linn.

2. chersis Hüb.
   *cinerea* Harr.
3. oreodaphne Hy. Edw.
4. libocedrus Hy. Edw.
5. insolita Lint.
6. perelegans Hy. Edw.
7. leucophæata Clem.
9. andromedæ Bdv.
10. separata Neum.
14. canadensis Bdv.
   *plota* Strck.
15. kalmiæ A. & S.
16. (?) capreolus Schauf.
17. drupiferarum A. & S.
18. vancouverensis Hy. Edw.
19. vashti Strck.
20. utahensis Hy. Edw.
21. albescens Tepp.
22. elsa Strck.

Genus 78. GARGANTUA Kirby.

1. eremitus* Hüb.
   *sordida* Harr.
2. eremitoides Strck.
3. gordius Stoll.
   *pœcila* Steph.
4. luscitiosa Clem.

Genus 80. HYLOICUS Hüb.

2. saniptri Strck.
9. plebeia Fab.
10. dollii Neum.
11. coloradus Smith.
12. sequoiæ Bdv.
   ♂ *coniferarum* Wlk.
14. strobi Bdv.
17. cupressi Bdv.

Genus 82. LAPARA Wlk.

1. bombycoides* Wlk.

Gen. 83. CHLÆNOGRAMMA Smith

1. jasminearum* Guér.

Genus 84. CERATOMIA Harr.

1. amyntor* Geyer.
   *quadricornis* Harr.

Genus 85. ELLEMA Clem.

1. coniferarum A. & S.
   *cana* Mart.
2. harrisii Clem.
   *coniferarum* Harr.
3. pineum Lint.

Genus 86. EXEDRIUM Grt.

1. halicarniæ* Strck.

Genus 87. DILOPHONOTA Burm.

1. ello* Linn.
2. œnotrus Stoll.
3. melancholica Grt.
   ♀ *cinerosa* Grt.
4. festa Hy. Edw.
7. merianæ Grt.

Genus 90. CAUTETHIA Grt.

3. grotei Hy. Edw.

Genus 91. ANCERYX Wlk.

3. edwardsii Butl.

## Subfam. 5. MANDUCINÆ.

Not represented.

* Indicates that the species is the type of the genus.

Subfam. 6. SMERINTHINÆ.

Genus 105. MARUMBA Moore.

33. modesta Harr.
*princeps* Wlk.
*populicola* Bdv.
var. occidentalis Hy. Edw.
34. imperator Strck.
35. cablei Von Reiz.

Genus 109. SMERINTHUS Latr.

3. vancouverensis Butl.
5. ophthalmicus Bdv.
var. pallidulus Hy. Edw.

Genus 110. EUSMERINTHUS Grt.

3. geminatus* Say.
4. cerisii Kirby.
5. astarte Strck.
7. myops A. & S.
*rosacearum* Bdv.

Genus 111. PAONIAS Hüb.

1. excæcata* A. & S.
2. pavoninæ Geyer.

Genus 112. CALASYMBOLUS Grt.

1. astylus* Dru.
*io* Gray.

Genus 113. CRESSONIA Grt. & Rob.

1. juglandis* A. & S.
*instabilis* Mart.
2. hyperbola Sloss.
3. robinsonii Butl.
4. pallens Strck.

Genus 116. ARCTONOTUS Bdv.

1. lucidus* Bdv.

Fam. XXII. BOMBYCIDÆ.

Genus 11. BOMBYX Linn.

1. mori Linn.

Genus 27. THAUMA Hy. Edw.

1. ribis* Hy. Edw.

F. XXIII. DREPANULIDÆ.

Genus 3. PEROPHORA Harr.

1. melsheimeri* Harr.
*egenaria* Wlk.

Genus 5. ORETA Wlk.

17. rosea Wlk.
*marginata* Wlk.
*americana* H.-Sch.
*formula* Grt.
18. irrorata Pack.

Genus 7. LACOSOMA Grt.

1. chiridota* Grt.

Genus 11. PLATYPTERYX Lasp.

13. arcuata Wlk.
*fabula* Grt
14. siculifer Pack.
15. genicula Grt.
27. fasciata Steph.
*uncula* Haw.

Genus 14. FALCARIA Haw.

4. bilineata Pack.

XXIV. CERATOCAMPIDÆ.

Genus 1. ANISOTA Hüb.

3. stigma Fab.
4. senatoria S. & A.
5. virginiensis* Dru.
*pellucida* S. & A.
*astynome* Oliv.

Genus 2. DRYOCAMPA Harr.

1. rubicunda* Fab.
var. alba Grt.
*pallida* Bowles.

Genus 3. SPHINGICAMPA Walsh.

1. bicolor* Harr.
*distigma* Walsh.
var. suprema Neum.
2. bisecta Lintn.
var. nebulosa Neum.
5. heiligbrodti Harv.

Genus 6. CITHERONIA Hüb.

2. regalis* Fab.
   *regia* S. & A.
   *laocoon* Cram.
   *ab.* sængeri Neum.
7. sepulchralis Grt. & Rob.
8. infernalis Strck.
11. imperialis Dru.
   *imperatoria* S. & A.
   *didyma* Beauv.
   var. punctatissima Neum.
   var. nobilis Neum.

Genus 7. COLORADIA Blake.

1. pandora* Blake.

## Fam. XXV. SATURNIIDÆ.

Genus 3. ATTACUS Linn.

13. cinctus Tepp.
18. erycina Shaw.
   *hesperus* Cram.
   *splendidus* Beauv.

Genus 6. SAMIA Hüb.

1. cecropia Linn.
2. columbia Smith.
3. gloveri Strck.
   var. reducta Neum.
4. californica Grt.
   *ceanothi* Behr.
   *euryalus* Strck.

Genus 7. CALLOSAMIA Pack.

1. calleta Westw.
   *polyommata* Tepp.
2. promethea Dru.
3. angulifera Wlk.

Genus 8. TELEA Hüb.

1. polyphemus* Cram.
   *paphia* Linn.
   *fenestra* Perry.
   var. oculea Neum.

Genus 35. TROPÆA Hüb.

8. luna Linn.
9. rossi Ross.

Genus 47. SATURNIA Schrank.

17. galbina Clem.

Genus 54. CALOSATURNIA Smith.

1. mendocino* Behrens.

Genus 58. AUTOMERIS Hüb.

11. zelleri Grt. & Rob.
39. pamina Neum.
   var. aurosea Neum.
40. zephyria Grt.
47. io Fab.
   *varia* Wlk.
   *fabricii* Bdv.
   *corollaria* Perry.
48. lilith Strck.

Genus 62. HEMILEUCA Wlk.

1. yavapai Neum.
2. juno Pack.
3. grotei Grt. & Rob.
4. diana Pack.
5. maja Dru.
   *proserpina* Fab.
   var. lucina Hy. Edw.
6. nevadensis Stretch.
7. californiæ Wright.
8. electra Wright.

Genus 63. ARGYRAUGES Grt.

1. neumoegeni* Hy. Edw.

Genus 67. PSEUDOHAZIS Grt. & Rob.

1. eglanterina* Bdv.
   var. shastaensis Behrens.
   var. denudata Neum.
   var. marcata Neum.
2. nuttalli Strck.
   var. arizonensis Strck.
3. hera Harr.
   *pica* Wlk.

Genus 68. EULEUCOPHÆUS Pack.

1. tricolor* Pack.
2. sororius Hy. Edw.
3. hualapai Neum.
4. neumoegeni Hy. Edw.

## F. XXVI. LASIOCAMPIDÆ.

Genus 85. PHYLLODESMA Hüb.

4. americana Harr.
   *ilicifolia* A. & S.
   *occidentis* Wlk.
   *carpinifolia* Bdv.
5. ferruginea Pack.
6. californica Pack.
7. roseata Stretch.
   *mildei* Stretch.
8. alascensis Stretch.

Genus 90. GLOVERIA Pack.

1. arizonensis* Pack.
6. gargamella Strck.

Genus 100. HETEROPACHA Harv.

1. rileyana* Harv.

Genus 117. CLISIOCAMPA Curt.

5. californica Pack.
   *pseudoneustria* Bdv.
6. fragilis Stretch.
7. strigosa Stretch.
9. erosa Stretch.
10. thoracica Stretch.
11. incurva Hy. Edw.
12. disstria Hüb.
    *neustria* A. & S.
    *sylvatica* Harr.
    *drupaceurum* Bdv.
13. americana Fab.
    *castrensis* A. & S.
    *decipiens* Wlk.
    *frutetorum* Bdv.

Genus 120. ARTACE Wlk.

1. punctistriga* Wlk.
   var. rubripalpis Feld.
2. albicans Wlk.
   *punctivena* Wlk.

Genus 129. TOLYPE Hüb.

1. laricis Fitch.
   *minuta* Grt.
2. velleda* Stoll.
3. distincta French.

Genus 144. APATELODES Pack.

1. torrefacta A. & S.
   var. floridana Hy. Edw.
2. angelica Grt.
   *hyalinopunctata* Pack.
3. indistincta Hy. Edw.

G. 145. ACRONYCTODES Hy. Edw.

1. insignata* Hy. Edw.

Genus RHAGONIS Wlk.

1. bicolor* Wlk.

## Fam. XXVII. PINARIDÆ.

Not represented.

## Fam. XXVIII. ZEUZERIDÆ.

Genus 1. QUADRINA Grt.

1. diazoma* Grt.

Genus 4. TRYPANUS Ramb.

9. populi Wlk.
10. angrezi Bail.
11. mucidus Edw.
12. brucei French.
13. centerensis Lintn.
14. macmurtrei Guér.
15. nodosus Lint.

Genus 8. HYPOPTA Hüb.

6. bertholdi Grt.
7. manfredi Neum.
8. henrici Grt.

Genus 19. PRIONOXYSTUS Grt.

1. robiniæ Peck.
   ♀ *plagiatus* Grt.
   *crepera* Grt.
2. reticulatus Lint.
4. querciperda Fitch.
5. nanus Strck.

Genus 21. COSSULA Bail.

1. basalis Wlk.
   *slossoni* Hy. Edw.
   *magnifica* Bail.

* Indicates that the species is the type of the genus.

Genus 27. ZEUZERA Latr.

4. decipiens Kirby.
   *pyrinus* ‡ Fab.
5. canadensis H.-Sch.

## Fam. XXIX. HEPIALIDÆ.

Genus 1. HEPIALUS Fab.

8. desolatus Strck.
15. gracilis Grt.
16. californicus Bdv.
17. mustelinus Pack.
18. baroni Behrens.
19. lenzi Behrens.
20. modestus Hy. Edw.
21. confusus Hy. Edw.
22. inutilis Hy. Edw.
32. hyperboreus Moeschl.
33. pulcher Grt.
34. labradoriensis Pack.
35. furcatus Grt.
40. hectoides Bdv.
43. sequoiolus Behrens.
44. sangaris Strck.
45. mendocinolus Behrens.
46. mathewi Hy. Edw.
47. mcglashani Hy. Edw.
48. behrensi Stretch.
    ♀ *montanus* Stretch.
    var. tacomæ Hy. Edw.
49. rectus Hy. Edw.
50. anceps Hy. Edw.
51. auratus Grt.

Genus 3. STHENOPIS Pack.

1. argenteomaculatus* Harr.
2. argentatus Pack.
3. quadriguttatus Grt.
4. purpurascens Pack.
5. thule Strck.

* Indicates that the species is the type of the genus.

## A NEW GENUS OF LARRIDÆ.

BY WILLIAM J. FOX.

### DIPLOPLECTRON gen. nov.

Head broader than the thorax; mandibles bidentate at apex, the outer tooth by far the longest, the outer margin is incurved medially, or very slightly emarginate, in the ♂ the mandibles are shorter, broader and the outer margin seems to be entire. Eyes converging towards the vertex, so that the distance between them at that point is about equal to half of that at the mandibles; ocelli round, convex, and situated so as to form a rather high triangle. Antennæ situated very low down, the middle lobe of clypeus extending up between them, rather long, very slightly thickened medially (the thickening is more obvious in the ♂) and narrowed to apex, alike in both sexes, *i. e.*, those of the ♂ are not formed into a spiral as in *Dinetus*. Prothorax large and very prominent, not emarginate above, and the anterior portion is not cut off so suddenly as in most of the allied genera; when compared with the dorsulum it is fully two-thirds as long; metathorax longer than the dorsulum, with no distinct enclosure. Anterior wings with an extremely short marginal cell, which is broadly truncate at apex, and has a long and distinct appendiculate cell. There are three cubital or submarginal cells, the first of which is longer than the two others combined, the second submarginal cell is triangular; the first and second recurrent nervures are received by the first and second submarginal cells respectively, as in *Dinetus*. Anterior tarsi of ♀ with a comb formed of long, slender, widely separated spines; the ♂ has no tarsal comb; middle tibiæ of both sexes with two spurs. Last dorsal segment of ♀ with an elongate-triangular pygidium.

While not closely allied to any described genus, it should be placed, in my opinion, after the genus *Dinetus*, according to Kohl's arrangement of the genera. *Diploplectron* has been formed for the reception of *Liris*(?) *brunneipes* Cress. from Colorado and Nevada.

## Synopsis of the HORMIINÆ of North America.

BY WILLIAM H. ASHMEAD.

The Braconids belonging to this group are few in number, and very closely allied to the Doryctinæ, Rhyssalinæ and Rhogadinæ, but are readily separated from these groups by the subdiscoidal nervure being interstitial with the anal nervure. *Hormiopterus* Giraud comes very close to *Dendrosoter* Wesmael; *Chremylus*, with wings removed, resembles *Pambolus* Haliday, while *Hormius* Nees comes closest to *Rhyssalus* Haliday.

### Table of Genera.

Median cell much shorter than the submedian cell along the externo-medial nervure.

Antennæ at the most 12-jointed..... .....**Chremylus** Haliday.

Median and submedian cells of an equal length.

Antennæ multiarticulate from 17- to 36-jointed.

Recurrent nervure not interstitial with the first transverse cubital, but joining an angle in the second submarginal cell.....**Hormius** Nees.

Recurrent nervure interstitial with the first transverse cubital.

**Hormiopterus** Giraud.

### CHREMYLUS Haliday.

In Europe but a single species is known, *C. rubiginosus* Boh., recorded by Marshall as having been reared from *Bruchus rufimanus* Boh., *B. seminarius* Linn. and *B. granarius* Sch.; also from *Tinea pellionella* Linn. In our fauna I have recognized two species distinguished as follows:

*FEMALES.*

Head, mesoscutum, scutellum and basal and apical abdominal segments black.

First branch of cubitus rather strongly curved inwardly.

**C. terminalis** sp. n.

Head black, rest of body rufo-piceous.

First branch of cubitus almost straight.....**C. nigriceps** sp. n.

*MALES.*

Head and thorax black; abdomen rufous..... .....**C. nigriceps** sp. n.

1. **Chremylus terminalis** sp. n.

♀.—Length 18 mm. Head, mesoscutum and basal and apical abdominal segment black, rest of body dull ferruginous; antennæ, mandibles, tegulæ and legs,

including coxæ, pale ferruginous; palpi pale. Head rugulose, the face with some long white hairs; thorax faintly shagreened, with three punctate impressed lines, the laterals uniting with the median before attaining the base of the scutellum; scutellum polished, with a crenate furrow across the base; mesopleura smooth, or nearly so; polished, shagreened at the sutures, and with a slight longitudinal crenate furrow near the middle; metathorax finely rugose, distinctly areolated, with the angles subprominent. Wings hyaline, pubescent, the stigma large, fuscous, all the nervures pale or hyaline; the first abscissa of radius two thirds the length of the second; first branch of cubitus rather strongly curved inwardly; recurrent nervure short, scarcely half the length of the first transverse cubital nervure and interstitial with it. Abdomen broadly oval, wider than the thorax, 3-segmented, shagreened, smoother towards apex, the second segment the largest and broadest, the first and last about equal in length, blackish; the raised discal plate on the first about twice as long as wide, the sides parallel; ovipositor half the length of abdomen.

*Hab.*—St. Louis, Mo. (C. V. Riley).

Type in National Museum.

Allied to the European *C. rubiginosus*, but slightly smaller and differently colored, while the first abscissa of radius and the raised plate on first abdominal segment are longer proportionately.

2. **Chremylus nigriceps** n. sp.

♀.—Length 1.5 mm. Head black; thorax and abdomen rufo-piceous; antennæ, except the four terminal joints (which are black) and legs, honey-yellow; collar and tegulæ yellowish. Head transverse, rugulose, the face slightly convexly prominent; antennæ as long as the head and thorax, filiform, 12-jointed, the first flagellar joint very slightly the longest, the following about two and a half times as long as thick; thorax with distinct parapsidal furrows that converge and meet just before reaching the base of scutellum, the middle lobe with a median longitudinal furrow; the surface, except anteriorly, where it is finely alutaceous, is smooth and shining; scutellum polished, with a large crenate fovea across the base; metathorax finely rugulose, areolated, truncate behind, the angles somewhat acute. Wings hyaline, the stigma and costa brown, the internal nervures yellowish or pale; recurrent nervure interstitial with the first transverse cubital, the first abscissa of radius a little longer than half the length of the second. Abdomen oval, 3-segmented, not longer than the thorax, polished, shining, but with a strong lens exhibiting an alutaceous sculpture towards base; plate of first segment a little longer than wide, with raised lateral margins; second segment nearly as long as the first and third united; ovipositor scarcely one-third the length of abdomen.

The ♂ has the head and thorax entirely black, but otherwise agrees with the female.

*Hab.*—Jacksonville, Fla.

Types in coll. Ashmead.

**HORMIUS** Nees.

The type of this genus, *H. moniliatus* Nees, was reared from *Tortrix corylana* Fab. The only other species, *H. pectiventris* Wesmael,

known to the European fauna, Marshall believes to be a variety of the former.

Our species may be tabulated as follows:

Honey-yellow species ..... 2.
Head and thorax black.
Metathorax rugose, but more or less distinctly areolated.
Legs, except hind femora, which are black or fuscous, rufous; abdomen, except first segment, rufo-piceous; antennæ black, or brown-black, multiarticulated, ♀ ..... **H. americanus** Ashm.
Legs, including coxæ, pale ferruginous, or brownish yellow; abdomen, except first segment, ferruginous; antennæ 30-jointed, towards base pale, ♂ ..... **H. erythrogaster** sp. n.
Metathorax finely rugulose, not areolated.
Legs and collar pale honey-yellow; abdomen brownish piceous, pale yellowish at base beneath; ovipositor a little longer than half the length of abdomen, black; antennæ, except first two joints, black; 19-jointed, ♀ ..... **H. pallidipes** sp. n.
2.—Head, except the clypeus and mandibles, black.
Antennæ, except first two joints, black; 18–19-jointed, ♂ ♀.
**H. atriceps** sp. n.
Antennæ pale, 20-jointed, ♂ ♀.
Mesothoracic lobes, the middle at base and the laterals toward outer margin, scutellum at sides, metathorax and shield of first abdominal segment dusky; ovipositor one-fourth the length of abdomen.
**H. vulgaris** sp. n.

1. **Hormius americanus** Ashm., Bull. No. 1, Col. Biol. Asso. 1890, p. 16.

♀.—Length 2.6 mm.; ovip. 0.4 mm. Black; tegulæ and legs, except the femora, rufous; the femora obfuscated, the posterior pair almost black; abdomen rufous. Head and thorax, except the middle lobe posteriorly, smooth and shining; middle lobe posteriorly just in front of scutellum wrinkled or rugose; mesopleura polished with a smooth, longitudinal furrow at base; scutellum smooth, with two large, shallow, crenate foveæ at base; metathorax rugulose, indistinctly areolated; antennæ long, black, multiarticulated (broken at tips), the joints of flagellum a little more than thrice as long as thick. Wings hyaline, strongly iridescent, the stigma and venation brown, the second submarginal cell twice as long along its lower side as along its upper side, the first abscissa of radius a little shorter than the second transverse cubital. Abdomen rufous alutaceous, the plate of the first segment sculptured and with parallel raised lateral margins.

*Hab.*—West Cliff, Col.

Type in coll. Ashmead.

The single specimen of this species was taken by Mr. T. D. A. Cockerell.

2. **Hormius erythrogaster** sp. n.

♂.—Length 2.8 mm. Head, thorax and first abdominal segment, except the lateral membranous parts, black; palpi whitish; mandibles ferruginous; an-

tennæ brown-black, the three or four basal joints pale or yellowish, especially beneath. Legs honey-yellow, the tarsi faintly dusky. Abdomen rufo-piceous or ferruginous, varying somewhat in depth of coloring. Head and thorax smooth, polished; face below antennæ faintly punctate; metathorax rugulose, with only a trace of a long central area; antennæ long and slender, much longer than the body, tapering toward tips, 30-jointed, the first flagellar joint the longest, the others shorter and slightly gibbous at the middle, giving them a cord-like appearance; thorax with two furrows that converge and meet before the scutellum, the middle lobe with a delicate grooved line on its basal half; scutellum smooth, with a large crenate fovea at base; metathorax rugulose, with medial carinæ. Wings hyaline, the stigma and venation light brown, the recurrent nervure joining an angle in the second submarginal cell, the first abscissa of radius about as long as the second. Abdomen long-oval, shining, but with the surface finely, minutely wrinkled, the second segment very much longer than any of the others, about as long as the third, fourth and fifth united, with an oblique grooved line at each basal angle.

*Hab.*—Cedar Point, Md., and District of Columbia.

Types in coll. Ashmead.

Comes closest to the European *H. moniliata* Nees.

3. **Hormius pallidipes** sp. n.

♀.—Length 1.8 mm. Head, antennæ, except two basal joints, and thorax, except collar and metapleura, black; collar and legs pale honey-yellow, the anterior and middle legs nearly white, the hind tarsi fuscous; metapleura rufo-piceous; abdomen brownish piceous, the ovipositor a little longer than half its length. Head and thorax polished, impunctured, the latter with distinct parapsidal furrows; metathorax finely rugulose, nearly smooth at base without areas; antennæ 19-jointed, one-fourth longer than the body. Wings hyaline, the stigma and venation light brown, the first abscissa of radius slightly longer than the second.

*Hab.*—Cedar Point, Md.

Type in coll. Ashmead.

The single specimen in my possession was kindly given me by my friend, Mr. E. A. Schwarz, who captured it Aug. 23, 1890.

At first sight I was inclined to believe this species the opposite sex of *H. erythrogaster*, also captured at Cedar Point, but its much smaller size, different colored legs, sculpture of metathorax and the paucity of joints in antennæ readily separate it.

4. **H. atriceps** sp. n.

♂ ♀.—Length 1.6—1.8 mm. Head, except clypeus and mandibles, black; rest of body honey-yellow; antennæ brown, the two basal joints and legs, except tibiæ and tarsi, yellowish white; all tibiæ and tarsi fuscous or dusky. Antennæ 18—19-jointed, longer than the body, the first flagellar joint the longest, the following joints from three to three and a half times as long as thick; thorax smooth, polished, with delicate parapsidal furrows, the metathorax feebly punctate, areolated, the central carina quite distinct. Wings grayish hyaline, the

stigma and venation light brownish yellow, the first abscissa of radius about two-thirds the length of the second. Abdomen oblong-oval, the surface finely wrinkled but shining; ovipositor less than half the length of abdomen.

*Hab.*—Jacksonville, Fla.

Types in coll. Ashmead.

Taken by sweeping.

5. **H. vulgaris** sp. n.

♂ ♀.—Length 1.5—2 mm. Honey-yellow, with usually some obscure or fuscous markings; antennæ brown, much longer than the body, 20-jointed in both sexes, the joints after the third about four times as long as thick; mesothoracic lobes (the middle at base and the laterals towards base), metanotum and plate of first abdominal segment more or less brownish or fuscous. Legs pale honey-yellow, the terminal joint alone dusky. Wings hyaline, the stigma and venation light brown or yellowish, the first abscissa of radius being two-thirds the length of the second. Abdomen elongate-oval, fully as long as the head and thorax united, shining, but with a faint alutaceous sculpture; ovipositor only one-fourth the length of abdomen.

*Hab.*—Jacksonville, Fla.

Types in coll. Ashmead.

Common in April. Allied to *H. atriceps*, but of a more elongate shape, and otherwise separated by the color of head and the number of joints in the antennæ.

## HORMIOPTERUS Giraud.

The type of this genus is from Algiers, and was reared from a lepidopterous larva, *Œcoceeis* sp., producing a gall on *Limoniastrum guyanianum*.

Two species have been recognized in our fauna as follows:

Entirely black; anterior wings with a distinct white band,
Hind coxæ and femora black; ovipositor two-thirds the length of abdomen.
**H. fasciatus** sp. n.

Dark fuscous; head, markings on thorax and usually the base and apex of abdomen ferruginous; wings subfuliginous, with some whitish streaks, but without a distinct white band.
All legs dull ferruginous; ovipositor half the length of abdomen.
**H. aciculatus** Cr.

1. **Hormiopterus fasciatus** sp. n.

♀.—Length 4 mm.; ovipositor nearly 2 mm. Black; face below antennæ and the mandibles, except teeth, dull ferruginous; antennæ, basally, ferruginous; hind coxæ and femora black; basal one-third of anterior wings, a transverse band across from the base of stigma and a spot in marginal cell at tip of stigma, white; otherwise smoky. Middle lobe of mesoscutum with a longitudinal carina posteriorly just in front of the scutellum; two crenate foveæ at base of

scutellum; mesopleura smooth; metanotum and abdomen, except apex of second and third segments, longitudinally striated; ovipositor a little shorter than abdomen.

*Hab.*—Manhattan, Kan.

Type in coll. Ashmead.

Described from a single specimen received, some years ago, from Mr. C. L. Marlatt.

Differs from *H. aciculatus* Cr. in color of body and wings, length of the ovipositor, in having smooth mesopleura, and in the striæ of the metanotum and abdomen being finer.

2. **Hormiopterus aciculatus** Cresson.

*Hormius? aciculatus* Cr., Trans. Am. Ent. Soc. vol. iv (1872), p. 190.

♀.—Length 5 mm.; ovip. 1.5 mm. "Fuscous, more or less tinged with dull ferruginous; head ferruginous, with white pubescence, not full behind the eyes, vertex [anteriorly] depressed; antennæ [longer than body], pale at base, dusty at tips; thorax fusco-ferruginous; pleura, metathorax and abdomen covered with dense longitudinal striæ; mesothoracic lobes smooth, the sutures rugose; tegulæ honey-yellow; wings narrow, subhyaline, apical half varied with pale fuliginous; a streak at tip of stigma, an oblique streak in first cubital cell, a spot at base of second cubital cell and a short transverse line at its apex, hyaline; stigma black, whitish at base and apex; legs ferruginous, with sparse erect hairs; abdomen blackish fuscous, tinged with reddish at base [and usually at tip], clothed with short erect whitish hairs; sutures deeply incised, the second segment with a deep transverse line a little behind the middle; ovipositor about half the length of abdomen."

*Hab.*—Texas (Belfrage); Jacksonville, Fla. (Ashmead).

Type in National Museum, obtained with the Belfrage collection.

Several specimens of this species, agreeing in every particular with the type, I obtained in Florida, under oak bark in March.

## ON A SPECIES OF SIMULIUM FROM THE GRAND CANON OF THE COLORADO.

BY C. H. TYLER TOWNSEND.

During the past Summer, larvæ of a species of *Simulium* were met with very abundantly in a small stream in one of the branches of the Grand Canon, July 8th to 11th. This branch, or side canon, is the one down which the Hance trail leads, being situated about fifty-five miles in a straight line N. N. W. of Flagstaff, Ariz. It is a deep canon, about seven miles in length, and becomes boxed up in the lower part of its course. About two miles down in this canon a small stream takes its source from a spring at a point about 2500 feet below the rim. After flowing for a few rods the stream sinks, but reappears some distance down the canon, flowing on until it reaches the Colorado River, into which it empties. In this stream many colonies of the *Simulium* larvæ were found in places where the current ran swiftly over the smooth water-worn surface of the rock. In going up the stream from where it empties into the Colorado River to where it seeps out, a distance of fully three miles, I counted fifty-two colonies of the larvæ. There were six colonies below the lower fall, where the stream drops about forty feet over a shelf of rock (Archaean granite). It should be stated that the point where this stream seeps out is about 3000 feet below the rim of the canon, while the point where it empties into the Colorado River is about 5000 feet below the rim. There is, therefore, a fall of about 2000 feet in its uninterrupted course, or approximately 700 feet to the mile. The greatest fall is in the last mile or so. No larvæ were found in the few rods of its upper course, between the spring and the point where it sinks, the fall not being enough to form a swift current. The depths given are those below the south rim, which is 1000 feet lower than the opposite rim. The Colorado River is, at this point, about 2500 feet above sea-level, and the south rim about 7500 feet. These altitudes are from figures kindly furnished by the United States Geological Survey.

The larvæ were of all sizes at this date, from very small to apparently fully grown. In all cases they were attached to the smooth eroded surface of the rock in the swifter current, but were once found attached to leaves of grass growing in the stream. Empty whitened or yellowed pupa skins and cases were discovered in patches in some places. No live pupæ were noticed at the time, but on subsequent examination of material collected it was found that quite a percent-

age of pupa cases contained the fully formed pupæ, the flies having not yet issued. Besides these, larvæ of all sizes from many different colonies were collected No adults, whatever, were to be seen.

These larvæ are much larger than those of *S. pecuarum* and *S. meridionale*, the largest measuring 13 mm. in length, and differ as well in certain points of structure. It is, therefore, thought well to give a description of them.

*Fully grown larva.*—General color of alcoholic specimens blackish, more or less mottled with whitish, the posterior extremity whitish, especially ventrally. Very elongate in form, narrowed on anterior half, segments of posterior half gradually widening to anal extremity, which is stout, with the ventral surface strongly bulged. *Head* (see figs. 1 and 2) nearly quadrangular, a little longer than wide, dark brown or blackish in color, corneous, with two approximated, irregular black dots on each side near lateral margin (see fig. 1), and several rows and groups of nearly concolorous markings on dorsal portion, as shown in fig. 1. *Antennæ* pale, nearly as long as one-half anterior width of head, 3-jointed, first joint very elongate and narrow, not swollen, slightly curved, with a somewhat faint transverse suture on basal two-fifths, cylindrical below suture, beyond suture very slightly and somewhat irregularly narrowing to tip; second joint narrower than tip of first, straight and of equal width, except slightly widened at base, a little more than one-third as long as first joint, and with two small, triangular, bud-like processes, one on each side at base, springing from the junction of the two joints and approximated to the second joint; third joint

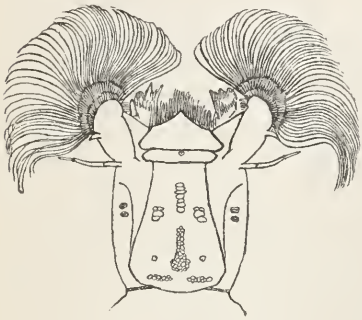


Fig. 1.

Fig. 2.

extremely small, short, minute, triangular, but a little longer than wide, about same shape as the minute processes at base of second joint (see fig. 1). *Fans* (see figs. 1 and 2) consisting of about sixty scythe-shaped rays each, the microscopically thinly hairy on outer side, sharply widened dorso-ventrally on about their basal one-fourth, and when spread, presenting the appearance about middle of widened portion of a crescentic serrate line extending over the width of fan near base. *Mandibles* elongate, rather stout, nearly twice as long as wide, furnished with teeth on inner side at apex; four large teeth on apex, nine or ten teeth behind these gradually decreasing in size, except that the second of these is larger than the first; a large tooth still behind these, with a small one directly beside it; mandibles furnished with dense brushes of hairs apically, more or less hiding the teeth, and basally, also with a regularly set fringe of hairs extending inward from anterior median portion (see fig. 3). *Maxillæ* furnished on inner portion with a dense tuft of hairs, on outer with a blunt, subconical, horn-like process (see fig. 4).

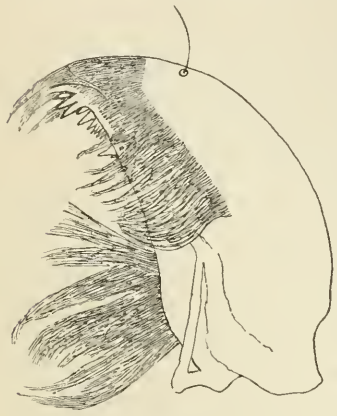


Fig. 3.

*Thoracic proleg* 4-jointed, elongate, subconical, truncate at end, last joint furnished with at least thirty obliquely longitudinal rows of hooks, and probably more; at base of these there is a marginal transverse row of bristles on side toward body (the proleg being flexed forward) extending around laterally, but wanting on outer surface. *Stigmata* (see fig. 5) showing on the dorsally tuberculiform extremity of body as a wide, transversely corrugated, blackish, more or less irregular circlet, either flattened and slightly indented dorsally, or slightly scalloped; at base dorsally with an X-shaped crossing, or branching of chitinous rods, the two anterior branches

Fig. 4.

extending a short distance forward beneath the integument; a soft, retractile, primarily 3-branched organ just anterior to these on dorsum, each branch being subdivided into five smaller branches or papillæ. Length, 11–13 mm.; width of head about 1 mm.; of anal portion $1\frac{3}{5}$ mm. Described from many specimens.

Fig. 5.

*Pupa* (see fig. 6).—General color pale brownish yellow on the thoracic portion, abdomen darker; head, wing and leg cases, and filaments pale yellowish, the head sometimes brownish; prothoracic filaments arising from a single stalk on each side, which branches at base into usually eight filaments; these do not subdivide. Third and fourth abdominal segments with five or six brown hooks or spines on posterior margin of dorsum. Eyes of adult, showing through the pupal skin in some cases, exhibit a remarkable difference in size of facets of upper and lower portion, those of lower half of eye (seen from side) not more than one-fourth as large as those of upper half; division between large and small facets very marked and abrupt, in a line parallel with the longitudinal axis of the head. Length (excluding filaments) 4.5–5 mm.

Fig. 6.

*Cocoon*, or *case*.—Massed in coral-like aggregations. Open at top, but enveloping all of the pupa, except the filaments or the extreme anterior portion of the hunch-backed thorax. Length 4–5 mm.

## EXPLANATION OF FIGURES.

Fig. 1.—Head segment of larva, dorsal view (enlarged).
" 2.—Idem, ventral view (enlarged).
" 3.—Mandible (greatly enlarged).
" 4.—Maxilla (greatly enlarged).
" 5.—Anal extremity showing breathing organs, dorsal view (enlarged).
" 6.—Pupa, lateral view (enlarged).

## NOTES ON LECANIUM, WITH A LIST OF THE WEST INDIAN SPECIES.

BY T. D. A. COCKERELL.

The Coccid genus *Lecanium* Illig. consists at the present time of about eighty nominal species, and is practically cosmopolitan. Signoret, in 1873, divided the genus into six series, some of which might be regarded as distinct genera or subgenera.

### FIRST SERIES.

Consists of flat and often viviparous species, of which *L. hesperidum* L. may be taken as the type. The others are *L. acuminatum* Sign., *L. angustatum* Sign., *L. frenchii* Mask., *L. lauri* Boisd., *L. longulum* Dougl., *L. maculatum* Sign., *L. mangiferæ* Green, *L. minimum* Newst., *L. tessellatum* Sign., and *L. viride* Green. If this group were to receive a subgeneric name, *Calymnatus* Costa, 1827, is apparently available.*

(1.) **Lecanium hesperidum** (L.) Sign.—In January, 1892, Mr. W. Harris sent me, from Cinchona, Jamaica (5000 feet altitude), two little scales found on an orchid of the genus *Stelis*. They were in poor condition for examination, and the largest only 3 mm. long; color pale brownish. So far as could be made out, they were the young of *hesperidum*, but it is singular that, except for this instance, the species has never been found in Jamaica. [Since this was written I have found a single adult ♀ of *hesperidum*, with young, on the midrib of the upper side of a mango leaf, in Kingston.]

(2.) **Lecanium mangiferæ** Green.—Fairly common in Kingston, Jamaica, on *Mangifera* and *Jambosa*. First found by Mrs. Swainson. This species, which has also been found at Demerara, is easily recognized by the subtriangular shape and the branched hairs along the margin. Eggs are produced, but the young larvæ at first take shelter beneath the body of the parent.

* So far as I can gather from Signoret's work, it seems that *Calypticus* Costa was first applied in 1829 to *C. spumosus* Costa, which is *Pulvinaria vitis*. Therefore *Calypticus* is not properly a synonym of *Lecanium*, but might, according to very strict priority, be brought forward to replace *Pulvinaria*.

(3.) **Lecanium longulum** Dougl.—Mr. C. A. Barber sent me this from Antigua, where it infests pigeon-peas. Later, I found it abundantly, mixed with *L. oleæ*, on the branches of a tree in Kingston. The tree, which was not identified, has 3-foliolate leaves, the leaflets lanceolate, entire, pubescent above, beneath pale, with strong veins. I also have specimens received from Mr. Newstead, found on *Euphorbia* (under glass) in Cheshire, England. Many of the *Antigua* specimens show holes where parasites have escaped.

When the scales become dry, they curl up and change color. Such specimens might be referred to Signoret's second series, but on the whole, it seems best to place the species in the first series, having regard to all its characters. The following notes are additional to the information given by Douglas in his description :

Scale (Jamaican specimen) about 4 mm. long and 2 mm. wide, of the flattish type, but fairly convex, dorsum rounded, not keeled, shiny. Color, when alive, appearing dark grayish ; when removed from the plant and seen with a lens, it has a very pale ground color, tinged with pinkish or yellowish, and much gray markings. To be more precise, there is a rather broad dorsal stripe of pinkish, bordered first by a pale yellow line on each side, which is broken up into spots, and outside that by a dark gray line. From the last run numerous blackish lines, radiating towards the margin, but not reaching it. There is, outside the dark gray line, a tendency to similar lines, which, crossing the radiating ones, produce a somewhat tessellated effect. The old scales become light brown.

The anal plates are brown, rather broad, so that together they form a square. Eyes dark purple.

The margins of the scale have simple hairs, rather longer than in some species ; the marginal spines are peculiar, being sunk in squared incisions, from which they do not usually project. There are two spines in each incision (four pairs of spines in all), which are either short and equal, or one is longer than the other, and projects beyond the incision.

The posterior cleft is pinkish in fresh specimens ; its sides are contiguous, but separate slightly after boiling in caustic soda. After boiling in soda the scale appears closely and conspicuously pitted with gland-spots.

The antennæ are described and figured by Douglas ("Ent. Mo. Mag.," 1887, p. 97). It appears to me that there are eight joints, as described by Douglas, although Maskell's *L. chirimoliæ*, which is

supposed to be the same, has only seven joints. It seems possible that *L. chirimoliæ*, although abandoned by its author (Tr. N. Z. Inst. 1890, p. 16) is a valid species after all. The legs are not described by Douglas. The femur is about one-third longer than tibia; tibia not twice as long as tarsus. Tarsal knobbed hairs long and stout; claw short and thick. Femoro-tibial and tibio-tarsal joints dark. Hairs arise from the distal ends of the coxa and trochanter, the trochanteric one being the longer.

The eggs are oval, as in other species.

(4.) **Lecanium tessellatum** Sign.—A very remarkable species, found hitherto in hot-houses in Europe, on a palm (*Carysta*). Some time ago Mrs. Swainson brought me some lignum-vitæ leaves, gathered in Kingston, Jamaica, which I then put by. Turning them over later, I was surprised to find a curious flat *Lecanium*, which agrees well with Signoret's *tessellatum*. This example, 5 mm. long and 4 mm. broad, was spoiled by a parasite, which had escaped through a small hole. On Dec. 29, 1892, I was so fortunate as to find another scale, also on a lignum-vitæ leaf, at Mr. Gardner's residence in Kingston. This latter specimen was not parasitized, and on removing it from the leaf, it was interesting to see a crowd of young larvæ, which, on being exposed to the light, scattered in all directions.

The following descriptive notes are intended to supplement those given by Signoret:

Female scale flat, very slightly convex, broad-oval or shield shaped, shiny, dark chestnut-brown, strongly rugose under a lens. The tessellations are as given by Signoret; ten sutures could be counted along the margin. The posterior cleft is about two-fifths total length of scale, its sides contiguous. Anal plates together forming nearly a square; margin of scale slightly granulose, but no distinct hairs; no lateral spines; substance of scale sparsely pitted with gland-dots.

Legs slender, tarsus very little over one-half length of tibia; tibia not much shorter than femur; two hairs spring from the distal end of coxa, and apparently two from the trochanter. A young individual on a leaf is flat, oval, whitish, with fine radiating grooves. This example is less than 2 mm. long.

*Larva* pale orange, but nearly colorless by transmitted light; shape long oval, legs extending far beyond body. Last joint of antenna with some long hairs. Tibia a *little* longer than tarsus; digitules of claw curved, slender, ordinary; clubbed hairs of tarsus

peculiar, both long, but the upper one filiform, with no distinct knob, the lower stout and longer, with a very distinct knob.

The posterior cleft of the larva is widely squared for its hindmost half; and from it spring two cylindrical tubercles; not extending beyond its mouth, bearing each a long straight hair—the usual caudal filaments. Between these tubercles is a pair of hooked organs, the hooks pointing away from the central line. This arrangement in the larva is interesting, and deserves further study.

## SECOND SERIES.

This series consists of convex elongated (or at least not hemispherical) species, which have been classed together for convenience, but do not appear to form a natural group. They are *L. assimile* Newst., *L. begoniæ* Dougl., *L. berberidis* Schr., *L. elongatum* Sign., *L. fitchii* Sign., *L. genistæ* Sign., *L. juglandis* Bouch., *L. mori* Sign., *L. persicæ* Fab., *L. piceæ* Schr., *L. pruinosum* Coquill., *L. sallei* Sign., and one or two others. *L. persicæ* is very near to some species referred to the third series; it is not confined to the peach, for although I have it from Isleworth, England, on peach (Q. Manville Fenn), what seems to be the same thing is received from Meissen, Saxony (C. F. Schaufuss), where it was found on *Vitis vinifera* and *Spiræa*.

(5.) **Lecanium begoniæ** Dougl.—Mr. C. A. Barber sent me from Antigua some leaves of *Terminalia catappa*, on which were many specimens of a *Lecanium*. I was at first inclined to consider it a new species, but it is so near to *L. begoniæ* (of which I have Demerara specimens, sent by Mr. Newstead) that I now doubt whether it is even a distinct variety.

The scales are abundant on the leaves; along the midrib on the upper side, but below more numerous, and scattered; twenty-two out of thirty-five on the under side of one leaf show holes where parasites have escaped. The parasite is a Chalcidid, with a large and thick tibial spur; femur and tibia brown; tarsus whitish; stigmal vein rather long, bifurcate at end; post-marginal about as long as stigmal.

Female scale rather over one-eighth inch long, broad-oval seen from above, moderately convex; ends flatter than sides, so that the outline seen from the side is pyramidal, while seen from one end it is rounded. Scale shiny, somewhat granulose, especially at sides, so dark brown as to appear black when adult, though some are obvi-

ously brown. In outline, color and texture, these Antigua scales exactly resemble the Demerara *begoniæ*, but my specimens of the latter are smaller, and have a rather more pronounced anal notch.

The structure of the scale is noteworthy, consisting of distinct oblong plates, each having in its centre a circular gland-spot. This is only seen by transmitted light.

On the *Terminalia* leaves from Antigua were also plenty of *L. oleæ* Bern.

(6.) **Lecanium assimile** Newst., var. *amaryllidis*, n. var.—In numbers on the leaves of *Amaryllis*, sp., in Antigua, sent by Mr. C. A. Barber. Scale about 3 mm. long, or less; black, with a pale margin, or red-brown. The pale margin is finely striate-plicate; the black portion is shiny, examined by transmitted light it appears brown.

Derm with scattered gland-dots. Sides of posterior cleft contiguous, the cleft short, not nearly twice as long (counting from tip of anal plates to margin) as length of anal plates. Anal plates pale, long wedge-shaped, the two posterior angles of the triangle much greater than the anterior one. Margin with but few hairs, these small, slender, with a slight tendency to be knobbed; marginal spines single, each in a deep squared incision, beyond the mouth of which it does not project.

Tibia about one-fourth longer than tarsus; femur about one-fourth longer than tibia; distal end of tibia with two hairs, one short, the other rather long.

Antennæ with apparently eight joints; third joint longest, but fourth almost as long, second next longest; then fifth, sixth and eighth subequal; then first; then seventh. It is difficult to make out the joints, as some of them show constrictions, or "false joints," but I think the statement here given is correct. There is a hair on first joint, one at end of fourth, one at end of fifth, and at end of sixth, and several on the eighth.

This is very likely a distinct species, but nearly all of Mr. Newstead's short description of *assimile* will apply to it. *L. assimile*, has 7-jointed antennæ, and the hairs on them seem to be disposed differently. The slight difference in the stated proportions of tibia and tarsus, and in the size of the scales, cannot count for much.

Several specimens of *amaryllidis* show holes where parasites have escaped.

## THIRD SERIES.

Consists of hemispherical species, with the skin more less tessellated, living on trees and shrubs in North America and Europe. About twenty-six species are considered valid, but several of these are very closely allied. I have been able to examine the following:

*L. æsculi* Koll., Ince, Cheshire (Newstead).

*L. distinguendum* Dougl., Delamere Forest, Cheshire (Newstead). One of these has been parasitized.

*L. pyri* Schr., Isleworth, Middlesex (Q. M. Fenn).

*L. ribis* Fitch, Norfolk (Newstead). On *Ribes rubrum* Meissen, Saxony, July, 1892 (C. F. Schaufuss). I think this species has not yet been recorded from Germany.

*L. rosarum* Snell., on *Rosa centifolia* Meissen, Saxony (Schaufuss); also what I take to be the same species on *Prunus domestica* Meissen (Schaufuss).

*L. tiliæ* L., on *Tilia grandifolia,* Oberblasewitz, 1890 (Schaufuss). This species, *æsculi,* and *ulmi,* are very much alike. Although it was two years since the Oberblasewitz scales were collected, I found, on crushing a scale for examination, a very small colorless mite, alive and walking about! Could it have been with the scale all this time, or do these mites breed in old scales?

*L. ulmi* L., Ince, Cheshire (Newstead).

The group represented by the third series is distinct enough to receive a subgeneric name, and may be called *Eulecanium,* taking *L. tiliæ* as the type.

## FOURTH AND FIFTH SERIES.

So far as I know the species of these two series, they are strictly of one group, the only difference being that in the fifth series the characteristic ridges are seen in the adults, while in the fourth series they are only well seen in young scales. Mr. Ashmead named the group *Bernardia,* taking *L. oleæ* as the type; in a letter to the U. S. Department of Agriculture, I changed this name to *Neobernardia,* on account of preoccupation in botany, but concerning this, see "Journ. Inst. Jamaica," 1892, p. 142. It appears, however, that the name *Saissetia* was formerly used for *L. coffeæ* (see "Zool. Record" for 1865), and if it can now be taken up, it has priority.

(7.) **Lecanium depressum** Targ.—Mr. Barber has sent a scale from Antigua which I think may be referred to this species, though it is possibly distinct. He found it on garden *Hibiscus*, the double and single red varieties, and remarks that it is enormously fertile.

Female scale—long. 4, lat. 2, alt. 1½ mm. Dark chocolate-brown, elongate, convex, very shiny, somewhat obscurely transversely ridged, margin granulose, not crenulate. An old scale is pale brown, very finely reticulate all over with red-brown. The young are brown, dorsally keeled, and strongly transversely ridged.

A young specimen examined had unbranched hairs around the margin, and very long spines at the lateral incisions. Color after boiling in soda, transparent, with central parts, legs, etc., red-brown. Eyes twice as far from base of antennæ as from margin; caudal filaments nearly straight, slightly curved outwards.

(8.) **L. oleæ** Bern.—Very common in Kingston, Jamaica, on various trees and shrubs; also sent from Antigua by Mr. Barber. It varies in color from black to brown; on March 8, 1892, Dr. Strachan sent me a branch of *Ficus carica*, gathered in Kingston, covered with *L. oleæ*, all of them brown. Perhaps the name *testudo* Curtis, which cannot well represent a distinct species, may be used for this brown form.

(9.) **L. hemisphœricum** Targ.—Very common and destructive in Kingston, Jamaica, especially on creepers. Mr. A. Fowler brought me a fruit of *Anona muricata* almost entirely covered by this species, and presenting a most singular appearance. It also occurs at Cinchona, 5000 feet altitude, on *Dendrophthora cupressoides* (W. Fawcett); at Port Antonio, on *Chrysanthemum* (A. J. Hopwood); and elsewhere. In Antigua, Mr. Barber finds it a "terrible pest to variegated *Eranthemum*," and sends also a pale variety of it, which he found on *Salvia*. I noticed that very young scales from Antigua, on *Eranthemum*, were pale with three conspicuous transverse pinkish bands.

Mr. Caracciolo records this scale from Trinidad, where it is found on guava.

(10.) **L. filicum** Boid.—On various ferns at Manchester Cottage, Kingston, Jamaica.

Adult scale brown, like *hemisphœricum*, but immature specimens longer and white. Margin of scale with clubbed hairs. The edge of the scale orange-brown by transmitted light, appears crowded with black dots; these seem to extend more or less all over the scale.

Lateral spines distinct, twice as long as the hairs. There is a slight tendency to have ridges, as in *oleæ*, but in the adult this fades away, leaving the sides of the scale obscurely furrowed.

With a lens the surface of the scale is seen to be covered with minute pale dots. There are pale dots at intervals along the lines of the ridges.

There can be no reasonable doubt that this is *filicum*, but in many particulars it resembles *L. clypeatum* Dougl., which must be very closely allied.

## SIXTH SERIES.

I have studied none of the species of this series. Mr. Crawford appears to have used the name *Cryptes* in MS. for *L. baccatum* (see Maskell, Tr. N. Z. Inst., 1891, p. 21), and perhaps, if necessary, this could be brought forward for use in a subgeneric sense.

Kingston, Jamaica, Dec. 31, 1892.

## THE GALERUCINI OF BOREAL AMERICA.

BY GEORGE H. HORN, M. D.

The essay of Dr. LeConte published in the Proc. Acad. 1865, pp. 204–222, was intended as a *Prodromus* of a more extended work when the accumulation of material would have made the work more perfect as to the species themselves, and a more nearly complete as to the contents of our fauna. In the same journal, in 1873, Crotch published a few notes on the tribe. Since the work of LeConte a small number of species have been described.

In 1875 the eleventh volume of the "Genera" appeared from the able hand of Chapuis, and which formed the basis of the table of genera given in the "Classification of the Coleoptera of North America."

The Galerucini treated in the following pages form one of the two divisions or sub-tribes, into which the tribe Galerucini is divided by all recent authors in the following manner:

Hind thighs slender, adapted for walking..... .....GALERUCINI.
Hind thighs thickened, adapted for leaping.....HALTICINI.

This distinction is ample for those with some entomological tact, whose experience in a general way will enable them to place doubtful forms in their approximately correct relationship, but it must be admitted that forms will occasionally present themselves in which the aggregate of an insect's structure must be given weight when characters that are considered more especially distinctive fail.

The femoral characters is without doubt the most constant, and least liable to give rise to doubt. There are, however, some Galerucini in which the thighs are quite as much thickened as in some Halticini. An instance in which the hind thighs of one of the latter group are scarcely thickened will be treated in a supplement to the present essay.

As a rule, the anterior coxæ are separated in the Halticini and contiguous in the Galerucini, but exceptions occur in both sub-tribes, although the characters may be said to have value next to that drawn from the femora.

The hind tibiæ in the Halticini are nearly always provided with a

terminal spur often largely developed or modified. The exceptions to this rule are very few. In the Galerucini the hind tibiæ are very often without spurs, but the absence of these spurs is less characteristic of the Galerucini than is their presence of the Halticini. It can very readily be understood why a spur is important on a hind tibia of a saltatorial insect, giving, as it does, a point of resistance in the act of leaping.

In the Halticini the general rule is that the third joint of the antenna is equal to or longer than the fourth, while in the Galerucini the third joint is usually smaller. There are, however, exceptions in both sub-tribes.

The characters have been given in the order of their importance and constancy, so that by having regard for them all it seems possible to solve all doubtful points.

It hardly seems necessary to enter into any detailed discussion of the various characters used in classification. With one there will doubtless be difficulty, which there seems no way of surmounting. The first joint of the hind tarsus plays, justly, an important role, but it has been found impossible to draw any absolute line of demarcation. In cases of doubt in using the table regard must be had to the aggregate of the characters of the insect after the manner indicated for the separation of the higher sub-divisions.

Chapuis, in dealing with the large number of genera, has found it necessary to divide them into twenty-seven groups. Of these eleven are represented in our fauna, as follows: Cœlomerites, Atysites, Drabroticites, Phyllobroticites, Scelidites, Luperites, Metacyclites, Agelasticites, Galerucites, Cerotomites and Sermylites, to which two others have been added to accommodate some troublesome genera in our fauna—Androlyperites and Phyllecthrites. In the comparatively few genera in our fauna an ordinary analytical table would suffice for their separation, but for the purpose of bringing our genera in relation with the best work hitherto done on these insects the groups adopted by Chapuis have been indicated in the table.

Fortunately, it has been found necessary to indicate but two new genera, while four genera hitherto unknown in our fauna have been introduced,—*Triarius*, *Malacosoma*, *Malacorhinus* and *Luperodes*, the last named containing nearly all those formerly called *Luperus*.

*Galerucella* is the equivalent of *Galerica* Chap., which has erroneously been placed among the genera with closed front coxal cavities. *Seelolyperus* is the equivalent of *Scelida* Chap.

Of the genera in the following table the following are thus far peculiar to our fauna: *Halticidea, Trachyscelida, Androlyperus, Phyllecthrus* and *Andrector.*

Chapuis arranges the tribes as they occur in our fauna in the following order: Phyllobroticites, [Phyllecthrites], Diabroticites, Agelasticites, [Androlyperites], Scelidites, Luperites, Atysites, Cœlomerites, Metacyclites, Galerucites, Sermylites and Cerotomites. It seems, however, that the arrangement produced by the analytical table gives quite as satisfactory results in the cabinet.

The following arrangement is the one proposed for our genera:

Anterior coxal cavities open behind.....2.
Anterior coxal cavities closed behind.....8.
2.—Claws of tarsi bifid (simple in ♀ *Monoxia*).....3.
Claws of tarsi appendiculate.....4.
3.—Tibiæ without terminal spurs.
Epipleuræ short, scarcely passing the middle of the elytra (*Cœlomerites*).
Outer edge of tibiæ deeply sulcate.....**Monocesta.**
Outer edge of tibiæ feebly carinate.....**Halticidea.**
Epipleuræ long, reaching nearly the apices of the elytra (*Atysites*).
Tarsal claws similar in the sexes, deeply bifid; antennæ longer than half the body.
Third joint of antennæ shorter than the fourth.....**Trirhabda.**
Third joint longer than fourth.....**Galerucella.**
Tarsal claws unlike in the sexes, narrowly bifid in males, simple in females; third joint of antennæ longer than the fourth; antennæ not reaching the middle of body.....**Monoxia.**
Tibiæ with terminal spurs (*Diabroticites*).
All the tibiæ with terminal spurs; outer edge rounded.....**Triarius.**
Anterior tibiæ without spurs; outer edge more or less carinate.
**Diabrotica.**
4.—Epipleuræ not distinct (*Phyllobroticites*).....**Phyllobrotica.**
Epipleuræ well defined.....5.
5.—First joint of hind tarsi slender, always longer than the next two, and sometimes longer than the next three.....6.
First joint of hind tarsi rather stout, sometimes as long as the next two, usually shorter.....7.
6.—First joint of hind tarsus decidedly longer than the next two, and in most cases equal to the three.
All the tibiæ without spurs (*Scelidites*).
Form elongate, parallel, anterior coxæ contiguous....**Scelolyperus.**
Form broadly oval and convex, anterior coxæ narrowly separated.
**Trachyscelida.**
Tibiæ with spurs, at least in part (*Luperites*).
All the tibiæ with spurs.....**Luperodes.**
First joint of hind tarsus equal to the next two and nearly as stout (*Androlyperites*).

Tibiæ without spurs; anterior coxæ distinctly separated. **Androlyperus.**

Tibiæ with spurs on the middle and posterior legs; anterior coxæ separated by a thin lamina **Malacorhinus.**

7.—Prothorax narrowed at base; all the tibiæ with spurs; sexes unlike in form (*Metacyclites*) **Metacycla.**

Prothorax not narrowed at base; all the tibiæ with spurs; sexes similar (*Agelasticites*) **Malacosoma.**

Prothorax not narrowed at base; tibiæ without spurs; sexes similar in form, but with differing antennæ, either in form or number of joints (*Phyllecthrites*) **Phyllecthrus.**

8.—Tarsal claws bifid; tibiæ without spurs (*Galerucites*) **Galeruca.**

Tarsal claws appendiculate.

First joint of antennæ longer than the fourth, third joint elongate (*Cerotomites*).

All the tibiæ with spurs; front of male not impressed **Cerotoma.**

Front tibiæ without spurs; front of male deeply transversely depressed. **Andrector.**

First joint of antennæ not longer than fourth, third joint shorter (*Sermylites*) **Agelasa.**

### **MONOCESTA** Clark.

Antennæ slightly thickened, a little longer than half the body, joints 1–3–4 about equal in length, third about half, joints 5–10 gradually shorter, eleventh about as long as the seventh. Head deflexed, moderately deeply inserted, eyes oval, entire; clypeus truncate, abruptly thickened behind the margin, labrum large, subacutely oval in front; maxillary palpi not very robust, the terminal joint acute, as long as the preceding joint and more slender; mandibles stout. Thorax short and broad, transversely depressed; scutellum moderately large, the apex oval; elytra somewhat inflated, broader behind, the epipleuræ very narrow, extending three-fourths to apex; prosternum not extending between the coxæ; metapleuræ moderately wide, narrower posteriorly. Legs not long; tibiæ slightly broadened at tip, the outer edge grooved, apex without spurs; tarsi rather broad in both sexes, claws bifid.

This genus contains species formerly placed in *Cœlomera*, from which it differs by characters of somewhat doubtful value. The species are numerous, and for the most part Brazilian, a number are found in Mexico, but one occurs in our regions. Chapuis placed the genus in a group, Cœlomerites, which may readily be distinguished from all others with entire anterior coxal cavities and bifid claws by the deeply grooved outer edge of the tibiæ.

**M. coryli** Say, Journ. Acad. iii, p. 455; ed. Lec. ii, p. 220.—Oval, moderately convex, broader behind, yellowish testaceous, elytra metallic-blue, with a broad, transverse testaceous band at middle, broader at suture and sides. Antennæ pale brown. Head sparsely punctate, with a median impressed line from the occiput to the labrum, transverse impression feeble. Thorax more than twice as wide as long at middle, apex emarginate, base truncate, sides regularly arcuate, the margin slightly reflexed posteriorly, anterior angles slightly prominent, hind angles obtuse, disc transversely depressed, surface sparsely finely punctate; elytra twice as long as wide at base, dilated behind the middle, surface punctate, but less distinctly at apex and base. Body beneath and legs dull testaceous, the abdomen often darker. Length .40—.60 inch.; 10—16 mm.

*Male.*—Last ventral segment broadly and deeply transversely emarginate, a slight fovea at the apex of the notch.

*Female.*—Last ventral broadly, but not deeply emarginate.

This species varies greatly in size, and I think I have seen specimens larger than the measurements given above. The normal coloration is that described above, but specimens occur with less blue, and some almost entirely yellow.

Occurs in Virginia, Illinois and Kansas.

### HALTICIDEA n. g.

Head oval, not deeply inserted, the eyes oval, prominent and free, frontal tubercles distinct, not prominent; a transverse groove between the eyes; labrum transverse, faintly emarginate; maxillary palpi short and stout, the terminal joint conical, longer than the preceding joint. Antennæ slender, nearly half the length of the body; first joint slightly clavate, twice as long as the second, this a third shorter than the third joint, fourth joint scarcely longer than third, joints five to ten slightly shorter, eleventh longer and acute at tip. Thorax more than twice as wide as long, sides arcuate, hind angles not distinct, disc convex, with a median transverse impression, sometimes indistinct or obliterated at middle; elytra oval, slightly oblong, the epipleuræ distinct in front, but becoming internal behind the middle; anterior coxal cavities narrowly closed behind, the prosternum not visible between the coxæ. Legs moderate in length, the tibiæ scarcely broader at tip, the outer edge finely grooved, no terminal spurs; tarsi rather stout, the first joint about equal to the nex two; claws strong, deeply bifid, the portions widely divergent. Body glabrous.

This genus is proposed for several small species which might readily be mistaken for *Haltica* by their facies. Among the groups suggested by Chapuis it seems best placed in the Galerucites by its entire anterior coxal cavities, unarmed tibiæ and bifid claws, although it differs from them in its glabrous surface.

The only other representative of the group in our fauna is *Gal. externa*, beside which the species of the present genus seem rather out of place, but as classification should be based on structural characters and not facies, there seems no other course to pursue than to place the species in the Galerucites.

Suffrian has described, from Cuba, a *Haltica dichroa* (Archiv. für Naturgesch. 1868, p. 203) in such a manner as to lead one to suppose that it might possibly be a member of the present genus.

The species are closely allied, and not easy to separate sharply, by description, although easily separable in cabinet. The following characters will, with the description, assist in their identification:

Head and thorax smooth, punctuation scarcely evident.
Base of thorax regularly arcuate, hind angles not distinct; punctuation of elytra rather fine and moderately closely placed.....**placida.**
Base of thorax truncate at middle, oblique each side, hind angles distinct; punctuation of elytra coarse.....**modesta.**
Head and thorax very distinctly punctate, the former alutaceous.
Base of thorax arcuate, hind angles slightly evident; punctuation of elytra fine and not well impressed.....**delata.**

**H. placida** n. sp.—Oval, slightly oblong, subdepressed, yellowish testaceous, meta-pectus piceous, elytra metallic-blue; antennæ pale brownish testaceous. Head shining with minute scattered punctures. Thorax more than twice as wide as long, slightly narrowed in front, sides strongly arcuate, disc with a deep, median, transverse depression, which may be reduced to a fovea each side, surface shining, minutely sparsely punctate; elytra finely and moderately closely punctate, much smoother at apex. Body beneath sparsely pubescent. Legs pale yellowish. Length .12 inch.; 3 mm.

*Male.*—Last ventral with a broad, almost semicircular emargination.

*Female.*—Last ventral entire.

Three specimens—Arizona, doubtless from the southern part.

**H. modesta** n. sp.—Oval, slightly oblong, yellowish testaceous, elytra bluish green; antennæ yellow. Head smooth, sparsely minutely punctate, a slight median impression of the front. Thorax more than twice as wide as long, slightly narrowed in front, sides strongly arcuate, disc with a sharp, median, transverse depression, surface smooth, with a few punctures near the sides, hind angles small but distinct; elytra relatively coarsely, not closely punctate; punctures a little less distinct at apex. Body beneath and legs yellowish testaceous, sparsely pubescent. Length .10 inch.; 2.5 mm.

*Male.*—Last ventral truncate, with a small emargination at middle, disc of segment slightly flattened.

The only specimen examined is entirely yellow beneath, while the other two species have the meta-pectus piceous. With such limited material it is not possible to assert the constancy of the character.

Collected in Biscayne, Fla., by Mr. E. A. Schwarz.

**H. delata** n. sp.—Oval, slightly oblong, subdepressed, head and thorax yellow, sometimes piceous, elytra piceous, with a faint surface lustre. Antennæ piceous, the basal joints paler beneath. Head alutaceous, punctate. Thorax as in *modesta*, but without distinct hind angles, the transverse depression not deep; surface alutaceous, sparsely punctate; elytra not closely punctate; punctures feebly impressed, apex much smoother. Body beneath and legs yellow, meta-pectus piceous, distinctly bronzed. Length .11 inch.; 2.75 mm.

*Male.*—Last ventral truncate, with a small emargination at middle.

*Female.*—Last ventral entire.

In this species the head and thorax, while usually yellow, tends to become brownish or piceous. The meta-pectus is also similarly variable in color. The surface lustre of the elytra may be violaceous or bronzed, but in none of the dozen specimens before me is there any trace of blue.

Collected abundantly at San Antonio, Texas, by H. F. Wickham. Occurs also in Arizona.

### TRIRHABDA Lec.

Head broad, moderately deeply inserted, eyes oval, convex and entire. Antennæ slender, three joints the length of the body, first joint claviform, second small, but oblong, third not quite twice as long as the second, fourth longer than the third, joints 4–10 gradually decreasing in length, eleventh longer; labrum transverse, emarginate; maxillary palpi not very stout, last joint conical, acute, narrower than the preceding joint and about as long. Thorax much broader than long, widest at middle, the angles distinct, and more or less prominent; scutellum short, obtuse; elytra elongate, parallel, or slightly broader behind, distinctly margined at sides, the epipleuræ narrow, but extending somewhat posterior to the middle; prosternum not prolonged between the coxæ, these prominent and contiguous; middle coxæ slightly separated in front, contiguous posteriorly; metasternal side-pieces moderately broad, narrower posteriorly. Legs moderate, the tibiæ faintly grooved on the outer side, without spurs at tip; tarsi not long, the first joint as long, or a little longer than the next two; claws bifid, but somewhat dissimilarly in the sexes.

It seems not to have been observed by those who have had occasion to study the genus, that the claws are somewhat dissimilar in the two sexes. In the male the claws are narrowly bifid at tip, while in the female they are more broadly bifid posterior to the tip, seeming almost to be toothed.

The first attempt at a study of our species was made by Dr. LeConte (Proc. Acad. 1865, p. 219), who separated the species with

characteristic acumen. Later (Proc. Acad. 1873, p. 56) Mr. Crotch, in a few words, suppresses many of the species as mere varieties without giving any definite reasons for such action. The results of the present study confirm the views of Dr. LeConte, basing the separation of the species on structural characters not observed by either of the preceding authors.

Before giving the table of the species it is well to observe that, contrary to the idea expressed by Crotch, the species are far less variable in their markings than might have been expected. The elytral sculpture is also remarkably constant, and forms two fairly-well defined types, the first illustrated by *tomentosa* and *luteocincta*, in which the punctuation is so fine and dense as to appear almost as an opacity; the second form by *virgata* and *flavolimbata* has the elytra distinctly punctate and slightly asperate, the punctures closely placed, but evidently distinct.

In the following table the species are divided into two series, the first without any trace of metallic surface lustre on any portion of the body, while in the second there is more or less such lustre. There is no trouble in applying this character, except in some forms of *luteocincta*, in which the elytra are nearly black, but an examination of the plaga of the occiput, or the thoracic spots, shows the surface lustre very plainly.

The occipital spot is of far greater constancy and importance than would have been expected of so trivial a character. In about one-half the species the occiput has merely a small spot in front of the edge of the thorax, while in the other species a large transverse space is piceous, extending at times nearly to the eyes. It is true that in nearly all the species, when the head is unduly extended, a piceous band is visible across the occiput, but the difference between the two sets of species can be easily appreciated by an examination of such well-known forms as *canadensis* and *flavolimbata*.

The following table has been prepared as an aid to the separation of the species more fully described in the subsequent pages; a cabinet arrangement is suggested by the number preceding each species.

Surface of body without any trace of metallic lustre in the markings, these being piceous or brownish.....2.

Surface with metallic lustre in the markings, if not on the elytra at least on the head and thorax.....6.

2.—Thorax more than twice as wide as long; epipleuræ more or less piceous.

2. **brevicollis.**

Thorax not twice as wide as long; epipleuræ always pale.....3.

3.—Elytra very densely and finely punctured, the punctures so dense as to be indistinct as such.....4.
Elytra closely punctate, but the punctures are distinctly separated.....5.
4.—The yellow vittæ of elytral disc attenuate to apex.....1. **tomentosa.**
The yellow vittæ broad, parallel and entire.....4. **canadensis.**
The yellow vittæ divided at middle by a fine black line; thorax coarsely punctate and subopaque; body beneath almost entirely piceous. 5. **geminata.**
5.—Elytra normally vittate, as in *canadensis*.....3. **virgata.**
Elytra almost entirely pale, the darker vittæ indistinct or obliterated. 6. **cadnea.**
6.—Thorax smooth, impunctate; head with small occipital spot; elytra subtruncate, sutural angle acute, or even slightly prolonged....7. **nitidicollis.**
Thorax more or less punctate and impressed.....7.
7.—Occiput with a small piceous spot; elytra very finely punctate..9. **diducta.**
Occiput with transverse piceous space.....8.
8.—Punctuation of elytra comparatively rough.
Elytra normally vittate.....10. **convergens.**
Elytra entirely blue, except border.....13. **flavolimbata.**
Punctuation of elytra fine and dense.
Elytra yellow, with slender blue vittæ, resembling *nitidicollis*. 8. **Lewisii.**
Elytra blue, with a short discal vitta attenuate to apex, as in *tomentosa*. 11. **attenuata.**
Elytra green, blue, or purple-black.....12. **luteocincta.**

By a rare exception, specimens of *luteocincta* have a dull, yellow, indistinct vitta.

**T. tomentosa** Linn., Syst. Nat. ed. xii, p. 601; Lec., Proc. Acad. 1865. p. 220; *bacharidis* Weber, Abs. Ent. p. 57; Fab., Syst. El. i, p. 480; Oliv., Ent. vi p. 629, pl. 3, fig. 34; *lampyroides* Gmel., Ed. Linn. i, 4, p. 1731.—Form oblong, slightly broader behind; antennæ entirely piceous when fully mature, the fifth joint distinctly longer than the third. Head testaceous, with a small occipital spot piceous, surface coarsely obsoletely punctate. Thorax not quite twice as wide as long, the angles usually prominent, sides obtusely angulate, but variable, disc with a vague depression each side of middle variable in extent, surface sparsely indistinctly punctate, color yellowish with the usual three piceous spots; scutellum piceous, sometimes margined with testaceous; elytra piceous, opaque, the entire margin from humerus to apex testaceous, the disc with a testaceous vitta broader at base, gradually narrowed to tip, extending three-fourths to apex, surface densely finely punctate, and finely, inconspicuously pubescent; epipleuræ always pale; pro- and metasternum always pale, metasternum at least piceous at the sides. Abdomen pale at middle and piceous at sides, or at times entirely piceous. Legs yellowish testaceous, the outer side of the front tibia, the tips of the middle and hind tibiæ and the tarsi piceous. Length .34—.40 inch.; 8.5—10 mm.

*Male.*—Last ventral segment broadly, but not deeply emarginate; claws slightly bifid at tip, the two divisions equal in length.

*Female.*—Last ventral obtuse, entire; claws more deeply bifid, the inner division a little shorter and more divergent.

The variation observed in this species are of but little moment, and have been recorded in the description. Under this description Crotch was disposed to unite several others, assuming that the differences in color were merely varietal, but as these differences are supplemented by others, the sexual often being important, the species recognized by LeConte must be admitted.

Occurs on the Atlantic coast from Long Island to Florida, usually very abundant.

**T. brevicollis** Lec., Proc. Acad. 1865, p. 221.—Form rather more broadly oval than usual. Antennæ piceous, the underside of the three basal joints testaceous. Head dull yellowish testaceous with a small occipital piceous spot, surface nearly smooth, a few indistinct coarse punctures at middle of the vertex. Thorax more than twice as wide as long, slightly narrower in front, sides obtusely angulate, disc irregular, with a moderately deep oblique impression each side, the two meeting opposite the scutellum, surface sparsely indistinctly punctate, more evidently near the front angles; scutellum pale, piceous at apex; elytra dull yellow, with a common sutural piceous vitta broad at base, gradually narrowing to apex, a broad vitta from the humerus extending nearly to tip and joining the sutural by a narrow isthmus; surface closely and finely punctate, finely pubescent; epipleuræ piceous, except at humerus. Body beneath dull yellowish testaceous, the ventral segments with small piceous space at sides; femora yellow, tibiæ on the outer side and tarsi piceous. Length .31—.38 inch.; 8.5—9.5 mm.

*Male.*—Last ventral segment with a broad and moderately deep emargination; anterior tarsi very slightly dilated.

*Female.*—Last ventral entire.

This species resembles *canadensis*, but is known by the short and broad thorax, the black tibiæ and tarsi, and the usually black epipleuræ.

The variations are not great. The occipital spot is often indistinct. The piceous spots on the thorax are never conspicuous, and the middle one may be obliterated and the lateral small. The epipleuræ are usually black, except at base, but one specimen has been observed with the piceous color at apex only. The fifth joint of the antennæ is scarcely longer than the third. The tarsal claws are similar in the sexes, being rather widely bifid at apex, the inner portion slightly shorter, and at the same time divergent from the outer.

Occurs on the sea-coast from Florida to Texas.

**T. virgata** Lec., Proc. Acad. 1865, p. 220.—Oblong oval, less elongate than *tomentosa*, but narrower than *brevicollis*. Antennæ piceous externally, gradually paler to base, especially on the underside of the joints, fifth joint much longer than the third, the second and third together, but little longer than the fourth.

Head yellow, occiput with a median piceous spot, surface irregularly coarsely punctate. Thorax a little less than twice as wide as long, slightly narrower in front, the angles slightly upturned, disc with a deep oblique impression each side, transversely united across the middle, surface sparsely irregularly punctate, color yellowish with the three piceous spots well developed; scutellum piceous; elytra slightly broader behind the middle, surface relatively coarsely punctate, inconspicously pubescent, color dull black, the entire margin from humerus to apex yellow, disc on each side with a moderately wide yellow vitta, which gradually narrows near the tip, and in some instances joining the apical yellow margin; epipleuræ pale. Body beneath and abdomen nearly always piceous, excepting the pro- and mesosternum, and the middle of the metasternum. Legs testaceous, the tibiæ on the outer side and the tarsi brownish. Length .26—.36 inch.; 6.5—9 mm.

*Male.*—Last ventral segment with a broad, but very shallow emargination; tarsal claws widely bifid at tip, the inner division shorter and divergent from the outer.

*Female.*—Last ventral broadly semicircular, the margin entire; claws as in the male.

This species is one of those supposed by Crotch to be merely a variety of *tomentosa*, but it seems abundantly distinct. The elytral punctuation is much coarser and less dense. The tarsal claws of the male are deeply and divergently bifid. In the two characters mentioned the species approaches *brevicollis*, but differs from that species in the less transverse thorax and pale epipleuræ.

Occurs on the Atlantic coast from Massachusetts to Florida, from which point to Texas it is replaced by *brevicollis*.

**T. canadensis** Kby., Fauna Bor. Am. iv, p. 219; Lec., Proc. Acad. 1865, p. 219.—Oblong, similar in form to *tomentosa*. Antennæ piceous, the basal joints partly testaceous. Head yellow, with an oblong occipital piceous spot, surface sparsely punctate. Thorax not twice as wide as long, slightly narrowed in front, sides arcuate, or very obtusely angulate, angles scarcely prominent, disc with a vague oblique impression each side from the front angles to the middle of base, surface sparsely coarsely punctate, color yellow, with the three piceous spots usually small: scutellum piceous, sometimes partly pale; elytra more yellow than black, a narrow black sutural vitta extending nearly to apex a black vitta from humerus, which becomes broader behind the middle, then narrower at apex, incurving to join the sutural, disc densely finely punctured, not closely pubescent; epipleuræ pale; underside of body yellowish testaceous, except a slight darkening at the sides of metasternum and abdomen. Legs pale yellow, tarsi slightly darker. Length .28—.38 inch.; 7—9.5 mm.

*Male.*—Last ventral segment broadly, but not very deeply emarginate; claws narrowly bifid at apex, the inner division shorter.

*Female.*—Last ventral broadly semicircular; claws more deeply bifid, slightly more divergent.

The coloration of this species is remarkably constant even in the most remote localities of its occurrence. The black vittæ vary a

little in width, and in some specimens the lateral vitta does not join the sutural at apex.

An examination of the elytral sculpture shows that it approaches very closely the dense and fine form seen in *tomentosa*, differing from the coarser form of *virgata* and *brevicollis*. The markings, however, more nearly resemble those of the last two species, but in both there is more black than yellow, while the reverse is the case in *canadensis*. The sexual characters are more nearly those of *tomentosa*, as in the last two-named species the claws do not greatly differ in the sexes.

This species is probably the most widely distributed of any in our fauna. Specimens are known to me from Hudson's Bay region, Canada, New Jersey coast, Kansas, Nebraska, Colorado, Utah and California.

**T. geminata** n. sp.—Oblong, slightly broader behind. Antennæ entirely piceous when fully mature, the fifth joint a little longer than the third. Head, excepting the front piceous; occiput coarsely and closely punctate. Thorax much less than twice as wide as long, slightly narrowed in front, angles not prominent, sides arcuate, disc with very vague, oblique depression each side, surface subopaque, scabrous and coarsely punctate, color dull yellow, with the three discal spots of variable size; scutellum piceous; elytra in great part dull black, margin from humerus to apex yellow, disc on each side with a dull yellow vitta extending three-fourths to apex, itself longitudinally divided by a narrow black line, surface densely finely punctured and extremely finely pubescent; epipleuræ pale. Body beneath, except prosternum, piceous. Legs in great part piceous, except the underside of the femora. Length .20—.28 inch.; 5—7 mm.

*Male.*—Last ventral broadly, but feebly emarginate; claws cleft at tip, the inner portion slightly divergent and shorter.

*Female.*—Last ventral entire; claws more deeply cleft, the inner portion more divergent and shorter than in the male.

In order to properly appreciate this species it is necessary first to see a fully colored specimen. Even then it would probably be associated with *maritima* or *morosa*, from its form and appearance. Among the species without any metallic lustre this one is known by the greater part of the head being piceous and coarsely punctate, the thorax feebly impressed and rugose, the elytra opaque, with the feebly marked yellow vitta divided by a black line, and by the underside of the body almost entirely piceous.

Two specimens before me are fully mature and marked as above described, one is entirely testaceous and probably immature. A fourth specimen has the entire dark fuscous, and apparently only the border yellow, but a careful inspection shows the geminate yellow vitta a little paler than the rest of the surface.

Occurs at San Diego, Cal., and Arizona.

**T. caduca** n. sp.—Form oblong, slightly broader behind, color dirty yellow, each elytron with a narrow piceous sutural vitta and another very narrow from the humerus to apex, both more or less evanescent. Antennæ brownish, fifth joint scarcely longer than the second. Head yellow, with a piceous occipital spot, surface coarsely and roughly punctured. Thorax nearly twice as wide as long, sides arcuate, angles not prominent, disc vague, obliquely impressed each side; surface sparsely, but rather coarsely punctate, color yellow, with the usual three black spots; scutellum piceous, or bordered with yellow; elytra closely, but not densely punctate, the pubescence extremely short and inconspicuous, color dull yellow, with a narrow sutural darker border and a vitta from the humerus. Body beneath and legs yellowish testaceous. Length .22—.26 inch.; 5.5—6.5 mm.

*Male.*—Last ventral broadly and moderately deeply emarginate; claws narrowly bifid close to the tip, the inner portion slightly shorter.

*Female.*—Last ventral nearly semicircular, with a slight triangular notch at middle; claws more deeply bifid than in the male, the inner portion shorter.

At first glance this species would be supposed to be a *Galerucella* from its color and feeble markings. It could only be suspected of being a feebly colored *canadensis*, but it is more coarsely sculptured than that, and with the pubescence very indistinct.

In the most perfectly developed specimens the markings resemble *L. bivittatus*, but the vittæ may be almost entirely obliterated.

Owen's Valley, California, six specimens.

**T. nitidicollis** Lec., Proc. Acad. 1865, p. 219.—Oblong, nearly parallel, clear yellowish testaceous, each elytron with a sutural and narrow lateral bluish stripe. Antennæ piceous externally, the basal joints, except the first, paler; fifth joint much longer than the third. Head yellow, a small piceous occipital spot, occiput coarsely punctate. Thorax less than twice as wide as long, slightly narrowed in front, hind angles rounded, sides obtusely angulate, disc scarcely at all impressed, surface polished, color yellow testaceous, with the three spots small; scutellum pale; elytra densely feebly punctate, sparsely finely pubescent, apices subtruncate or sinnate, the sutural angle acute or even slightly prolonged, a narrow sutural stripe extending nearly to apex, a narrow vitta from the humerus joining the sutural near the apex; epipleuræ pale. Body beneath entirely pale, except the sides of the abdomen at base. Legs and tarsi pale. Length .26—.40 inch.; 6.5—10 mm.

*Male.*—Last ventral broadly, but not deeply emarginate; claws finely bifid at apex.

*Female.*—Last ventral broadly semicircular, entire at tip; claws more deeply bifid, the inner portion evidently shorter.

This species is known by its smooth and even thorax, and by the form of the apices of the elytra. The markings seem very constant, and vary but little in width.

Occurs in Colorado, Utah and New Mexico.

**T. Lewisii** Crotch, Proc. Acad. 1873, p. 56.

This name was suggested by Crotch for a form supposed to be a variety of *nitidicollis*, but it seems to be a valid species. While it has the form and color of that species the occiput has a large transverse plaga, the thorax is sparsely punctate and obliquely impressed each side, the elytra are not subtruncate, and the sutural angle is obtuse. On the whole, it is a little smaller than *nitidicollis*, but otherwise agrees in color and sculpture.

Occurs in Colorado.

**T. didneta** n. sp.—Oblong nearly, parallel, yellowish, elytra with bluish green vittæ. Antennæ brownish, pale at basal half, fifth joint not longer than the third. Head yellow, a small occipital spot, in and around which are a few coarse punctures. Thorax a little more than twice as wide as long, sides strongly arcuate, disc with a deep transverse depression at middle, surface indistinctly sparsely punctate and with the usual piceous spots small; scutellum piceous, bordered with yellow, or entirely pale; elytra in great part yellow, with a narrow bluish-green sutural vitta, a broader vitta from the humerus, which often joins the sutural near the apex, between these a narrow bluish line not reaching the base, surface densely finely punctured, but less so at base, very finely and indistinctly pubescent; epipleuræ, body beneath and legs, entirely pale. Length .24—.28 inch.; 6—7 mm.

*Male.*—Last ventral broadly, but not deeply emarginate; claws very narrowly bifid at tip, the inner portion a little shorter.

*Female.*—Last ventral broadly semicircular, with a very small semicircular notch at middle; claws more deeply bifid, the parts more divergent, the inner shorter.

This species resembles *nitidicollis* more than any other, but differs in its shorter and broader thorax, with deep transverse depression and punctate surface. In this species the apices of the elytra are rounded and the sutural angle very obtuse.

The only variation observed in this species is in the extent of the narrow blue line between the sutural and lateral vittæ.

Occurs in western Nevada and adjacent regions of California.

**T. convergens** Lec., Proc. Acad. 1865, p. 220.—Oblong, nearly parallel, body beneath almost entirely piceous, above pale yellow, the elytra with metallic-green vittæ. Antennæ piceous, the basal joints paler, fifth not longer than third. Head yellow, with a broad, transverse occipital piceous space, the surface rather coarsely punctured. Thorax less than twice as wide as long, not narrowed in front, sides arcuate, disc vaguely obliquely impressed each side, surface coarsely sparsely punctate; color yellow, with three piceous spots; scutellum piceous; elytra rather coarsely and somewhat roughly punctate, pubescence distinct, but not close, color in greatest part metallic-green, the side margin and apex yellow, and a yellow vitta on the middle of each elytron, nearly reaching the apex, usually parallel-sided, sometimes slightly narrower to tip; epipleuræ

pale. Body beneath, except the pro- and mesosternum, piceous. Legs pale, tarsi slightly darker. Length .20—.28 inch.; 5—7 mm.

*Male.*—Last ventral broadly and moderately deeply emarginate: claws narrowly bifid at tip, the parts nearly equal.

*Female.*—Last ventral broadly semicircular, usually entire, rarely with a feeble trace of a notch at middle; claws more deeply and widely bifid, the inner portion distinctly shorter.

This species is the smallest in our fauna. The elytral markings seem to vary very little. The sculpture of the elytra is rather coarse, resembling in this respect *virgata* and *flavolimbata*.

Occurs in Nova Scotia (Ulke), Kansas, Colorado and Wyoming.

**T. attenuata** Say, Journ. Acad. iii, p. 459; ed. Lec. ii, p. 223; Lec., Proc. Acad. 1865, p. 220.—Oblong, slightly broader behind. Antennæ piceous, gradually paler to base, fifth joint longer than the third. Head yellow, occiput with large piceous transverse space, surface moderately closely punctate. Thorax fully twice as wide as long, slightly narrowed in front, sides subangulate, disc sparsely, obsoletely punctate, a moderately deep oblique impression each side, color dull yellow, with the usual three piceous spots; scutellum piceous, or partly pale; elytra densely and finely punctured, finely pubescent, color in great part metallic-blue or green, the side margin and apex yellow, a discal yellow vitta extends from base a little beyond the middle, broad at base, gradually attenuate at apex, or sometimes bifid; epipleuræ pale. Body beneath pale, the sides of metasternum and abdomen piceous with metallic surface lustre. Legs yellow. Length .24—.30 inch.; 6—7.5 mm.

*Male.*—Last ventral segment feebly emarginate; claws finely bifid at tip.

*Female.*—Last ventral broadly semicircular, with a very slight notch at middle; claws bifid behind the apex, the inner portion shorter.

This species varies in the extent of the dorsal yellow vitta, which extends sometimes two-thirds to apex, or is a short spot at base, the usual extent being to the middle.

The elytral punctuation is dense and fine, as in *canadensis* or *luteocincta*. This removes it from suspicion of being a variety of either *convergens* or *flavolimbata*, both of which have the coarse sculpture of *virgata*. *T. diducta* has still finer sculpture and a small occipital spot.

Occurs in Kansas, Utah, Nevada and British Columbia.

**T. luteocincta** Lec., Proc. Acad. 1858, p. 88; Proc. Acad. 1865, p. 220.—Form oblong, usually nearly parallel, color variable: green, blue, purple, or purple-black. Antennæ piceous externally, gradually paler to base, fifth joint longer than the third. Head testaceous, with a large occipital space piceous, with more or less metallic surface lustre, sparsely punctate. Thorax not twice as wide as long, sides strongly arcuate, hind angles slightly reflexed, disc sparsely finely punctate, an oblique or oval depression each side, the three spots well marked; scutellum nearly always piceous, rarely partly pale; elytra oblong, nearly parallel, disc variable in color, margin and apex pale, surface densely

finely punctate, finely pubescent; epipleuræ pale. Body beneath piceous, with greenish surface lustre, except the pro- meso- and middle of metasternum. Legs testaceous, the outer edge of all the tibiæ and both sides of the middle and front femora piceous. Length .20—.38 inch.; 5—9.5 mm.

*Male.*—Last ventral with a moderately deep, almost semicircular emargination; claws slightly bifid at tip.

*Female.*—Last ventral with a more or less deep, nearly circular emargination, nearly closed posteriorly by an acute process from each side; claws bifid, slightly posteriorly to the apex, the divisions more divergent than in the male, the inner shorter.

Variation in this species is really greater than has been observed in any other. The color varies from green, which is not nearly so bright as in *flavolimbata*, through blue and purple to nearly black. In the latter forms there is always a trace of purple in the black, and the spots of the head and thorax always show more or less metallic lustre. In those forms of the latter color others will be observed with a dull yellow vitta extending from the base nearly to apex.

Without a considerable series the nearly black forms would be suspected of being varieties of *tomentosa* with the vitta obliterated, but the broad plaga of the occiput separate them. In any event the females may be the most readily separated from any other species by the sexual characters.

The distribution of this species is remarkable. Occurs in California from San Diego northward, also on the New Jersey coast, probably near Long Branch. The latter are all of the darker form, and are certainly very misleading in appearance.

**T. flavolimbata** Mann., Bull. Mosc. 1843, p. 308; Lec., Proc. Acad. 1865, p. 220.—Oblong, somewhat oval. Antennæ piceous, paler at base, especially on the underside, fifth joint but little longer than the third. Head yellow, occiput with a broad greenish plaga, which is moderately closely punctate. Thorax twice as wide as long, slightly narrower in front, sides arcuate, disc with a moderately deep transverse impression on each side, surface with a few scattered punctures; color yellow, with the three spots as usual; scutellum piceous, or partly yellow; elytra comparatively roughly punctate, the entire disc blue or green, the side margin and apex yellow; pro- and mesosternum yellow, sides of metasternum and abdomen piceous, with more or less metallic surface lustre. Legs and tarsi pale. Length .20—.32 inch.; 5—8 mm.

*Male.*—Last ventral segment broadly and moderately deeply emarginate; claws finely bifid at tip, the inner division slightly shorter.

*Female.*—Last ventral broadly semicircular, the apex entire; claws more deeply bifid, the division more divergent, the inner shorter.

Among the species with metallic ornamentation two only have comparatively roughly punctate elytra, the present species and *con-*

*vergens*. The latter having well defined and regular vittæ, will not be mistaken for this species. Small specimens of *attenuata* in which the vitta is reduced to the minimum do resemble this one, but the character of the punctuation and the female sexual characters readily separate it.

No specimens have been showing any trace of a discal yellow vitta, although Dr. LeConte supposed they might exist.

Occurs in Colorado, Utah, Lake Superior region, Nevada, northern California and southern Oregon. Found on Solidago (Cockerell).

**GALERUCELLA** Crotch.

Head not deeply inserted, usually with a distinctly impressed median line, frontal tubercles rather small; labrum moderately prominent, rounded in front; maxillary palpi stout, the terminal joint conical, a little longer than the preceding. Antennæ as long, or longer than half the body, filiform; third joint longer than the fourth, joints 4–10 gradually decreasing in length, the eleventh longer. Thorax usually twice as wide as long, and a little narrower in front, the disc with a median and lateral depressions with piceous spots; scutellum oval at tip; elytra oblong or oval, the lateral margin somewhat explanate in all but two species, surface irregularly punctate, usually coarsely, never really finely, the ornamentation variable; epipleuræ moderately wide, extending three-fourths to apex; anterior coxal cavities open behind, confluent at middle, the coxæ moderately prominent; middle coxæ contiguous, separated in three species by a distinct prolongation of the mesosternum reaching the metasternum. Legs not long, femora somewhat thickened, tibiæ carinate externally and without terminal spurs; tarsi rather stout, the first joint of the posterior not longer than the next two; claws bifid in both sexes, but more deeply in the females.

This genus was proposed by Crotch for those species formerly enrolled in *Galeruca*, in which the anterior coxal cavities are open behind. It includes in our fauna all those placed in *Galeruca* by LeConte (Synopsis, Proc. Acad. 1865), except *externa*, which is a *Galeruca*, and *maritima*, *morosa* and *erosa*, which are removed to *Monoxia*.

*Galerucella* and *Monoxia* are very closely allied genera, and some of the paler forms of *notata*, etc., are not easy to place, but the much shorter antennæ of *Monoxia* will distinguish the two. The male claws of the two genera are much alike, but the secondary sexual characters of the last ventral are better marked in *Galerucella*.

The sinuation of the elytral apex with the acute sutural angle is not in our species of specific value, as in *americana* there is great variability entirely independent of sex.

Two species in those following are also found in Europe, and have doubtless been introduced.

The following table will assist in the identification of the species, but the ornamentation is so variable that considerable latitude must be allowed, as in *americana* specimens without vittæ are quite common.

Elytra coarsely punctate, more finely toward the apex; antennæ similar in color above and beneath ..... 2.
Elytra comparatively finely and equally punctate; antennæ piceous above, pale beneath; sides of elytra distinctly explanate..... **xanthomelæna.**
2.—Elytra with vittate markings ..... 3.
Elytra not vittate. ..... 6.
3.—Elytra scarcely at all explanate; middle coxæ distinctly separated by the mesosternum ..... 4.
Elytra distinctly explanate; middle coxæ contiguous..... 5.
4.—Elytra very coarsely punctate, convex; thorax more or less shining and very indistinctly trimaculate; pubescence of surface (when present) erect. **americana.**
Elytra less coarsely and more closely punctate, not very convex; thorax opaque, trimaculate; pubescence recumbent ..... **sexvittata.**
5.—Sutural vitta indistinct or absent, the next inner vitta long, nearly reaching the apex..... **integra.**
Sutural vitta always distinct.
The next inner vitta joining the sutural at, or behind the middle. **notulata.**
The next inner vitta very short, basal..... **notata.**
6.—Color red, head red ..... 7.
Color dirty yellow, brown or piceous, occiput usually piceous. ..... 8.
7.—Elytra more coarsely punctured, the punctures with distinct intervals, surface shining..... **cavicollis.**
Elytra more finely and densely punctured, surface rather opaque. **rufosanguinea.**
8.—Middle coxæ distinctly separated by a prolongation of the mesosternum; thorax angulate at middle and subsinuate posteriorly, with obtuse hind angles..... **nymphææ.**
Middle coxæ contiguous; hind angles of thorax distinct.
Thorax irregularly punctate, with smoother areas along the apex and near the hind angles..... **tuberculata.**
Thorax quite densely punctured and opaque..... **decora.**

**G. americana** Fab., Syst. Ed. i, p. 489; Oliv., Ent. vi, p. 636, pl. iii, fig. 43; Lec., Proc. Acad. 1865, p. 215; *cribrata, conferta* Lec., loc. cit.—Form oval convex, of more pinguid facies than any other species, color dull yellow, elytra each with three piceous vittæ, more or less indistinct, or even wanting; surface sparsely pubescent. Antennæ piceous externally, paler at basal half. Head

coarsely and closely punctured, a vague median impression, color dull yellow, with sometimes a median darker line. Thorax usually more than twice as wide as long, although much narrower in the male, wider at base than apex, sides arcuate, or in some males very obtusely subangulate, disc convex, often even more usually with a vague median and lateral depressions, surface variably punctate, sometimes sparsely, more usually coarsely and closely; elytra oval with rounded humeri, the apices obtuse, or subtruncate in most females, the lateral margin not explanate, the marginal sulcus not evident, surface very coarsely, deeply and moderately closely punctate, sparsely pubescent, with three narrow piceous vittæ on each side, which are often entirely obliterated. Body beneath more finely and closely punctate, finely pubescent, color usually like the upper surface, but the metasternum and abdomen are sometimes piceous. Legs always pale. Length .14—.26 inch.; 3.5—6.5 mm.

*Male*.—Last ventral with a narrowly triangular incisure extending half the length of the segment; claws finely bifid close to the tip.

*Female*.—Last ventral more broadly triangularly emarginate; claws more deeply bifid and the divisions more divergent.

In this species the middle coxæ are distinctly separated by a prolongation of the mesosternum meeting the metasternum. The humeri are also more rounded, the metasternum shorter. The wings seem less feebly developed.

The variation in this species is carried to such a degree that it is not easy to find two specimens even reasonably alike. In form most of the females are as broadly oval as *G. externa*, and more convex, while the males are as oblong as any *Monoxia*. The general color varies but little, although the markings are very variable. Often the thorax shows no traces of the three spots, but they are never very well marked in any specimen. The vittæ on the elytra are slender, and when perfectly developed, which is rare, are nearly entire, but all gradations are seen from this to the perfectly plain form. The sculpture of the thorax varies greatly, specimens (always female) occur with the surface sparsely punctate with smooth intervals and without inequalities, and from this form they pass gradually to those with coarse and close punctures. The elytral sculpture does not vary so greatly as the thoracic, but extreme forms are quite different in appearance. When specimens are fresh or carefully preserved, the pubescence is always distinct, seeming to be more persistent in the males, the larger pinguid females soon losing the hairs. In those specimens in which the pubescence remains it will be observed to be in great part erect.

This species seems to be very widely distributed, specimens having been seen from the entire region east of the Rocky Mountains and the Rio Grande, and from Canada to the Gulf.

**G. sexvittata** Lec., Proc. Acad. 1865, p. 215.—Oblong oval, rather depressed as compared with *americana*, dull yellow or pale brown, opaque; thorax with three distinct spots, each elytron with three slender piceous vittæ. Antennæ entirely black. Head densely punctured, a vague median depression with a piceous line. Thorax twice as wide as long, distinctly narrower in front, sides arcuate, hind angles distinct, disc densely punctured and opaque, a vague depression each side a median piceous line and a spot each side; scutellum black; elytra slightly broader behind, humeri distinct, but obtuse; lateral margin not explanate, apices obtuse, sutural angles slightly retracted, disc rather densely punctured and opaque, on each side three entire piceous vittæ. Body beneath similar in color to the upper surface, the hind margins of the ventral segments darker. Legs concolorous, tibiæ on the outer side, tarsi and a median femoral spot piceous. Length .20—.24 inch.: 5—6 mm.

The sexual characters are as in *americana*. Dr. LeConte mentions a transverse depression on each side of the last ventral segment, but this is more or less evident in all the species. In the ample number of specimens examined no notable variation has been observed.

This species could only be mistaken for a variety of *americana*, and on the other hand some of the varieties of the latter might be mistaken for this, but the two may be separated by the much coarser and less close punctures of *americana*, which also has erect pubescence, while in *sexvittata* the pubescence is always recumbent and always present. From *integra*, which resembles the present in markings and somewhat in sculpture, *sexvittata* may be known by the separated middle coxæ.

Occurs from Pennsylvania to Louisiana.

**G. cavicollis** Lec., Proc. Acad. 1865, p. 216.—Oval, narrower in front, subdepressed; color dull red, slightly shining, very sparsely finely pubescent. Antennæ entirely black. Head red, coarsely punctured, without median depression, frontal tubercles smooth. Thorax nearly twice as wide as long, narrower in front, sides arcuate, or obtusely subangulate, hind angles distinct, base on each side obliquely sinuate, disc feebly convex, a broad depression each side and another along the middle, surface coarsely punctured, more densely in the depressions; scutellum red; elytra broader behind the middle, sides arcuate, margin explanate, humeri distinct, but rounded; sutural angle well marked, but obtuse; disc with coarse and deep punctures not crowded, less deep near the apex, interspaces smooth, shining. Body beneath red, the metasternum often piceous, sparsely finely punctate and finely pubescent. Legs variable in color entirely red to almost entirely piceous. Length .18—.22 inch.; 4.5—5.5 mm.

*Male.*—Claws finely bifid at apex. Last ventral segment broadly emarginate at apex, with a deep triangular depression limited by a sharply elevated line.

*Female.*—Claws more deeply bifid, the parts more divergent. Last ventral segment with a very slight emargination, in front of which is a slight fovea.

The middle coxæ are absolutely contiguous, the mesosternum is not prolonged between them, except as to the color of the legs no variation has been observed in this species.

*G. sanguinea*, of Europe, has been referred to as probably allied to this species, but an examination of that shows that it should be associated with *americana*, by reason of its convex form and not explanate elytral margin.

Occurs from Canada to the New England and Middle States westward to Wisconsin ; North Carolina (Lec.)

**G. rufosanguinea** Say, Journ. Acad. v, p. 299; ed. Lec. ii, p. 343.—Oval, narrower in front, subdepressed, dull red, subopaque, sparsely finely pubescent. Antennæ entirely black. Head entirely red, coarsely and densely punctured, and with a slight median depression. Thorax nearly twice as wide as long, slightly narrower in front, sides arcuate, hind angles distinct and slightly prominent, base on each side oblique, disc feebly convex, a broad fovea each side and a median depression, surface coarsely and closely punctured; scutellum red; elytra slightly wider behind the middle, sides feebly arcuate and distinctly explanate, humeri distinct, but obtuse; sutural angle well marked, but not acute; surface very closely punctate, rather coarsely at middle, more finely at sides and apex. Body beneath and legs dull red, metasternum somewhat darker. Length .18—.22 inch.; 4.5—5.5 mm.

*Male.*—Claws bifid at tip, the parts rather widely divergent. Last ventral as in *cavicollis*.

*Female.*—Claws similar to the male. Last ventral either simple, or with a very feeble fovea at the middle of the edge.

As in *cavicollis* the middle coxæ are contiguous. No variations have been observed.

This species and *cavicollis* are closely related, but the denser punctuation of the surface, together with the resulting opacity, will readily separate this species.

Occurs in Pennsylvania, Maryland, North Carolina, and at times abundant along the sea-coast.

**G. integra** Lec., Proc. Acad. 1865, p. 218.—Oblong, oval, not very convex dull yellow, feebly shining, sparsely clothed with fine recumbent pubescence, thorax trimaculate, each elytron with a subsutural and three discal slender stripes. Antennæ piceous, the four basal joints paler at base. Head closely, not coarsely punctate, a fine median depression and piceous line. Thorax not quite twice as wide as long, slightly narrower in front, sides arcuate, hind angles rounded, disc not very irregular, closely finely punctured, with more sparsely placed coarser punctures, then piceous spots, the median linear, the lateral small and round; scutellum pale; elytra scarcely widened behind the humeri, these distinct, but obtuse; sutural margin feebly prominent, disc closely punctate, the punctures gradually finer to apex, sutural angle obtuse, subsutural vitta not reaching base or apex, second and fourth entire usually united at apex, the third not reaching either base or apex. Body beneath colored as above, metasternum sometimes darker. Legs pale. Length .16—.20 inch.; 4—5 mm.

*Male.*—Last ventral segment with a very narrow triangular incisure extending nearly the length of the segment; claws finely bifid at tip.

*Female.*—Last ventral more broadly and less deeply triangularly emarginate; claws stouter and more deeply bifid.

In comparison with the other vittate species this one has the elytra more finely punctate than any, except, possibly, *sexvittata*. From the latter species, which it most resembles, it differs in having the middle coxæ absolutely contiguous. There is also a distinct subsutural vitta in the present species not seen in that. From the next two species it differs not only in the different arrangement of the vittæ, but also in the finer punctuation.

Occurs from Pennsylvania to Florida and Texas.

**G. notulata** Fab., Syst. El. i, p. 489; Oliv., Ent. vi, p. 636, pl. 3, fig. 44; Lec., Proc. Acad. 1865, p. 217; *bilineata* Kby., Fauna Am. Bor. iv, p. 220.—Oval, slightly oblong, moderately convex, dull yellow, sparsely clothed with fine, recumbent, silky pubescence; thorax trimaculate, each elytron with a subsutural and three discal vittæ. Antennæ piceous, the basal half paler. Head coarsely and moderately closely punctate, the median line impressed and piceous. Thorax nearly twice as wide as long, narrower in front, sides strongly arcuate, base on each side oblique, hind angles distinct, disc depressed each side with three piceous spots as in *integra*, more or less obliterated; surface coarsely, but not very closely punctate; elytra scarcely wider behind, humeri distinct but obtuse, lateral margin narrowly explanate, sutural angle obtuse, disc closely punctate, punctures coarse, but varying, finer toward apex, the subsutural vitta rarely reaches the base, the second vitta is oblique and joins the sutural at or behind the middle, the third is often nearly entire, the fourth starts at the umbone and often joins the sutural. Body beneath pale, with piceous metasternum. Legs pale. Length .14—.20 inch.; 3.5—5 mm.

The sexual characters do not differ notably from those observed in *integra*.

The markings of the elytra vary by obliteration to a great extent, so that at times it may require considerable tact to determine whether a specimen should be referred to this species or *notata*. When the markings are entirely obliterated, the resemblance to some Monoxiæ is very great, but the form of the claws, if a female, will enable the specimen to be placed.

Frequently specimens occur in which the vittæ seem to be elevated and subcostiform, these represent the *bilineata* of Kirby.

Occurs in the entire region east of the Rocky Mountains from Canada southward, also in New Mexico. Specimens are before me from California, but it has probably been introduced there.

**G. notata** Fab., Syst. El. i, p 488; Oliv., Ent. vi, p. 637, pl. 3, fig. 45; Lec., Proc. Acad. 1865, p. 218.—Oval, slightly oblong, dull yellow, opaque, sparsely clothed with fine recumbent pubescence, thorax trimaculate, each elytron with a sutural and three discal vittæ, the inner one short, basal. Antennæ piceous or

brown, paler at base. Head closely punctate, a moderate median depression, which is more or less piceous. Thorax twice as wide as long, slightly narrowed in front, sides arcuate, base on each side oblique, hind angles distinct, disc slightly depressed each side, surface closely punctate and opaque with three spots, the middle one linear; elytra very little arcuate on the sides, the margin somewhat explanate, humeri distinct, but obtuse; sutural angle obtuse, surface closely and not very coarsely punctate, punctures finer at apex, a subsutural vitta not reaching either base or apex; a short, slightly arcuate vitta at base, external to which are two vittæ, the outer one entire the inner abbreviated at both ends. Body beneath similar in color to the upper surface, the metasternum usually darker. Legs pale. Length .14—.20 inch.; 3.5—5 mm.

*Male.*—Last ventral segment deeply, but narrowly triangularly notched; claws widely bifid at tip.

*Female.*—Last ventral more widely triangularly emarginate; claws widely bifid at tip.

As in *notulata* and *integra*, the middle coxæ are contiguous. The punctuation is finer than in the former and a little coarser than in the latter. The elytral markings approximate those of some varieties of *notulata*, but a little experience will soon enable one to distinguish the two species.

Widely distributed with *notulata*, but no specimens have been seen from the Pacific coast.

**G. nymphææ** Linn., Syst. Nat. ed. x, 1758, p. 376; Oliv., Ent. vi, p. 643, pl. 3, fig. 31; *marginella* Kby., Faun. Am. Bor. iv, p. 308; Lec., Proc. Acad. 1865, p. 217; *sagittariæ* Gyll., Kby. loc. cit. p. 219; *femoralis* Mels., Proc. Acad. iii, p. 161; *luctuosa* Mann., Bull. Mosc. 1852, ii, p. 368.—Oval, slightly oblong, narrower in front, subdepressed, piceous-brown; thorax dull yellow, with three piceous spots; side margin, apex and epipleuræ of elytra yellowish, surface finely pubescent. Antennæ piceous, five or six of the proximal joints pale at basal half. Head piceous, frontal region pale, vertex and occiput densely punctured and opaque. Thorax twice as wide as long, sides rather strongly angulate, frontal angles small, prominent; hind angles nearly obliterated, disc with a large depression each side, which is densely punctured and piceous, a median narrow depression; surface, except in the foveæ, smooth and glabrous; elytra slightly broader behind, margin distinctly explanate, humeri distinct, but obtuse; sutural angle acute, surface coarsely and moderately closely punctate, much finer at apex. Body beneath piceous, last ventral segment pale. Legs pale. Length .18—.24 inch.; 4.5—6 mm.

*Male*—Last ventral segment slightly emarginate at apex, with an oval, sharply limited depression as in *cavicollis*, but smaller; claws rather deeply bifid; posterior tibiæ slightly arcuate.

*Female.*—Last ventral slightly emarginate, with a feeble depression near the middle of the apical margin; claws deeply bifid, the inner portion much shorter.

The middle coxæ are comparatively widely separated by a prolongation of the mesosternum meeting the metasternum.

Comparatively little variation has been observed in the specimens examined. The thoracic spots are, however, very inconstant as to size, but the coloration in other respects varies but little.

From the species with which this one might be confounded, it differs by the quite smooth thorax, pale elytral margin, the acute sutural angles, and finally, by the completely separated middle coxæ.

Much European bibliography and synonymy has been omitted, only that pertinent to our fauna being given.

Occurs abundantly throughout northern Europe and in the northern regions of our continent in Canada and the Hudson's Bay region. A specimen has been received from Mr. Wickham, collected at Luling, Texas. Received also from Oregon and Owen's Valley, California.

**G. tuberculata** Say, Journ. Acad. iii, p. 256; edit. Lec. ii, p. 220; *punctipennis* Mann., Bull. Mosc. 1843, p. 308.—Oblong oval, scarcely wider behind, subdepressed, opaque, finely pubescent, color variable from dull yellow to piceous. Antennæ entirely black. Head coarsely and closely punctate, occiput black, front and clypeus yellow. Thorax yellow, with three piceous spots, the central one larger and triangular, nearly twice as wide as long, somewhat narrowed in front, sides rounded or obtusely subangulate, hind angles distinct, base on each side oblique, surface somewhat shining, coarsely and closely punctured, smoother near the front angles and along the apex; elytra somewhat wider behind the middle, humeri distinct, but obtuse, sutural angle well defined, surface coarsely and deeply punctured, closely around the scutellum, much more finely and sparsely at sides and apex. Body beneath piceous, finely pubescent. Legs either entirely pale or piceous. Length .20—.24 inch.; 5—6 mm.

*Male.*—Last ventral broadly emarginate at middle, the disc with a deep semi-oval depression with sharply-limited edges; claws finely bifid at tip.

*Female.*—Last ventral with a very small notch at middle of apex; claws more widely bifid.

The middle coxæ are absolutely contiguous.

Two varieties of this species occur:

G. tuberculata Say.—Color dull yellow or reddish brown, the underside usually piceous; legs pale.

G. punctipennis Mann.—Piceous, the front and thorax yellowish.

Occurs in the Middle States (Lec.), Colorado, Idaho, Washington, California, Oregon and Vancouver.

**G. decora** Say, Long's Second Exped. ii, p. 294; ed. Lec. i, p. 195; *? salicis* Rand., Bost. Journ. ii, 1838, p. 31; var. *carbo* Lec., Proc. Acad. 1861, p. 358.—Form oblong, scarcely wider behind, not very convex, color dull yellow, brown or entirely black, surface with fine, short, silken pubescence. Antennæ entirely piceous, or with the proximal ends of the four or five basal joints pale. Head densely punctured, opaque, a finely impressed median line. Thorax twice as wide as long, narrower in front, sides arcuate, hind angles slightly prominent, base oblique each side, disc moderately convex, with a vague median depression and a shallow fovea each side, surface densely punctate and opaque, the three spots usually indistinct; elytra scarcely widened behind, humeri distinct, margin

explanate, sutural angle distinct, but not prolonged: surface coarsely, deeply and moderately closely punctate, somewhat finer toward apex. Body beneath finely and not closely punctate, feebly pubescent. Length .18—.22 inch.; 4.5—5.5 mm.

*Male.*—Last ventral segment emarginate at tip, the disc with a deep triangular depression limited by an elevated line; claws finely bifid at tip.

*Female.*—Last ventral either entire, or with a very feeble emargination at middle; claws stouter and more deeply bifid than in the male.

Var. **decora** Say.—"Dusky, elytra dull testaceous, sericeous, with golden-brassy hair."

In this form the head may be partly piceous. The thoracic spots distinct or not. The underside may be dull yellow or entirely piceous. Legs pale.

Var. ———.—Brownish testaceous, varying as in the preceding form.

This form seems to be labeled *sagittariæ* in most American collections, but the thorax in the latter is formed as in *nymphææ*, and many authors consider the two identical. *G. salicis* Rand. is probably the equivalent of this variety. Numerous specimens were found by Dr. LeConte in the Adirondack region infesting the willows.

Var. **carbo** Lec.—Entirely black, above and beneath.

Occurs in Canada, Massachusetts, New York, Wisconsin and Colorado in the paler forms, and in Nebraska, Washington and Oregon in the black form.

**G. xanthomelæna** Schrank, Enum. Ins. Aust. 1781, p. 78; Fairm., Gen. Col. Eur. iv, pl. 68, fig. 326; *calmariensis* Fab. Harris. Ins. Inj. Veg. ed. ii, p. 124; *gelatinariæ* Fab., Syst. El. i, p. 490; Oliv., Ent. vi, p. 631, pl. 3, fig. 36.—Oblong, subdepressed, scarcely wider behind, yellowish testaceous, finely pubescent, a black spot on the occiput, three on the thorax, a vitta from the humeral callus and a short vitta from the middle of base of each elytron. Antennæ piceous on the upperside, paler beneath. Head yellow, with a black occipital spot; surface moderately coarsely not closely punctate. Thorax more than twice as wide as long, slightly narrowed in front, sides arcuate, base slightly sinuate each side; disc with an oblique depression each side, a shallow fovea on the median line behind the apex; surface moderately, not closely punctate; elytra a little wider behind the humeri, these distinct, but obtuse; margin explanate, sutural angle well defined, not dentiform; surface moderately closely, not coarsely punctate, the punctures equal from base to apex. Body beneath piceous, the sides and apices of the ventral segments pale. Legs pale, each femur with a small piceous spot in front. Length .20—.28 inch.; 5—7 mm.

*Male.*—Last ventral emarginate, with a broad triangular depression; claws strong, deeply bifid.

*Female.*—Last ventral slightly emarginate, with a narrow triangular depression simulating an incisure; claws as in the male.

This species seems to vary but little, and only by the absence of the short stripe.

In recent years this insect has attracted much attention in our country from the damage done to the Elm trees, which are sometimes almost entirely defoliated. For an account of these ravages the reader will consult "Insect Life" and the reports of several experiment stations.

M. L. de Joannis, in Abeille iii, p. 84, adopts the name *cratægi* Forst. for this species, but I have not been able to satisfy myself that the description applies to the species under consideration. Forster, moreover, gives *Cratægus oxyacantha* as the food-plant of his species.

Occurs abundantly all over Europe, and in our country from Massachusetts southward.

**MONOXIA** Lec.

Head oval, moderately convex, not deeply inserted, front feebly or not impressed. Antennæ filiform, not longer than half the body, third joint as long as the first, fourth longer than the second, joints 6–10 subequal in length; labrum moderately prominent, truncate with rounded angles; maxillary palpi moderately stout, second and third joints obconical, the terminal conical and more slender; prothorax transverse, widest at base, except in *sordida;* scutellum oval at tip; elytra oblong, scarcely broader behind the humeri, closely and irregularly punctured, the side margin not prominent; epipleuræ narrow, but extending nearly to the tips of the elytra; prosternum entirely obliterated between the coxæ, the coxal cavities open behind. Legs moderate, the anterior tibiæ indistinctly grooved on the outer side, tibiæ without terminal spurs; tarsi shorter than the tibiæ, the first joint as long as the next two; claws dissimilar in the sexes, finely bifid in the male, absolutely simple in the female.

The definitive characters of the genus are—the anterior coxal cavities are open behind, the prosternum obliterated between them; the tarsal claws not appendiculate, but finely bifid in the male and simple in the female. In the group Atysites, to which it is referred by Chapuis, it may be known by the short antennæ, of which the third joint is longer than the fourth.

To Mr. Crotch we owe the observation that the differences in the claws are sexual and not specific, as Dr. LeConte was disposed to consider them. Chapuis seems not to have known the observation of Crotch, and expresses the view that the strictest account should be taken of the claws, and that the two sections indicated by LeConte, which we now know to be sexes, should be made distinct genera.

While the form of the claws in the comparatively small species was observed, the fact entirely escaped both LeConte and Crotch that some larger forms placed in *Galerucella* were similarly constructed. These will now take their places in *Monoxia*, with the result of making the genus a little less homogeneous in aspect, but leaving *Galerucella* more so by their absence.

LeConte seems to have had an idea that the vertical pygidium had some value, but in examining a large series it will be found that while the pygidium may be more or less vertical in the males of the small species, that member does not differ notably from that of other Galerucini in their females, nor in either sex of the larger species.

In accordance with the results obtained from a study of large series of all the species the following table is presented:

Larger species .27—.34 inch.; fifth joint of antennæ very obviously shorter than either the fourth or the sixth..... .....**puncticollis.**

Smaller species .10—.20 inch.; fifth joint of antennæ not shorter.

Thorax narrower at apex than at base.

Elytral punctuation rather fine and dense, a little coarser at base and near the scutellum; color usually entirely pale yellow, very rarely with spots. **consputa.**

Elytral punctuation comparatively coarse, scarcely finer at sides and apex than at base; color dull yellow, with numerous small black spots, often arranged in series.....**debilis.**

Thorax not narrowed at apex.

Elytral punctuation fine, pubescence fine; color yellowish, with numerous black spots with a tendency to coalesce along the suture.....**sordida.**

**M. puncticollis** Say, Journ. Acad. iii, 1824, p. 458; ed. Lec. ii, p. 222; *morosa* Lec., Pacif. R. R. Rep. p. 70; *maritima* Lec., Proc. Acad. 1865, p. 218; *erosa* Lec., Trans. Am. Ent. Soc. 1884, p. 28.—Form oblong, narrowed in front; surface finely pubescent, color variable from pale yellow to entirely black, or with the elytra vittate. Antennæ variable in color from entirely black to pale, generally with the outer half dark, the base pale, fifth joint always shorter than the fourth or sixth. Head coarsely and closely punctate. Thorax not quite twice as wide at base as long at middle, broader at base than apex, sides feebly arcuate, base broadly emarginate at middle, oblique each side, hind angles distinct; disc usually irregular, with broad, vague depressions each side, so that at times the sides of the thorax appear deplanate, a vague median impressed line, surface very coarsely and irregularly punctate; elytra closely punctate and finely pubescent, the punctures coarser near the base, fine and closer toward the sides and apex. Body beneath finely sparsely punctate and pubescent. Length .27—.34 inch.; 7—8.5 mm.

*Male.*—Claws finely bifid at tip; last ventral segment obtuse, with a short median linear impression near the apex.

*Female.*—Claws absolutely simple; last ventral obtuse, with a small notch at middle, from which proceeds a slight impression or a smooth line.

Varieties:—

Var. **puncticollis**, typical form.—"Dull yellowish brown; thorax confluently punctured, unequal; antennæ and two fillets on each elytron black."

"Body with minute hairs; head, above confluently punctured; clypeus and labrum glabrous; antennæ black; thorax rough, with excavated confluent punctures, immaculate, inequal; elytra with minute punctures, fillets obsolete, often wanting or hardly visible; thighs with a black spot, tibiæ and tarsi black."

The above is Say's description reproduced to bring before the student the evidence that the present species is really what Say had before him. The vittate forms seem to be much less common than the others. The elytral vittæ, two on each side, are placed—one arising from the side of the scutellum runs parallel with the suture extending three-fourths to apex, the second begins at the umbone, runs parallel with the side margin, curving inward at apex, but not reaching the suture. These vittæ may be more or less indistinct, or the lateral one may alone remain.

Specimens illustrative of this form have been examined from Colorado, Texas, Utah and Florida.

Var. ———.—Beneath piceous, head and thorax pale, elytra black with the suture, side margin and apex pale.

Specimens have been seen from California and the Atlantic coast.

Var. ———.—Totally black, including legs and antennæ.

Specimens have occurred with the preceding variety.

Var. ———.—Entirely dull yellow, the outer portion of the antennæ and the tarsi brownish.

This is the most abundant form, and is known from the Atlantic coast from Massachusetts to Florida; Colorado, Utah, New Mexico, Texas and California.

The legs vary in color with the body. As a general rule the pale bodies have pale legs, those entirely black have black legs, while the vittate, or the partially black forms, have the tibiæ externally, the tarsi and a space on the femora piceous.

It is probable that some objection may be urged to my identification of Say's species from the fact that he states its length as "three-twentieths of an inch," while the species is never that small, and is usually twice that size. It is probable that Say made a slip of the pen in this case, as is well known in several other instances in his works.

With the above identification it is readily seen why Say saw a resemblance to *baccharidis*, as he must doubtless have known *Trir-*

*habda canadensis*, which later authors, even, have assumed to be a variety of *baccharidis* = *tomentosa*. Those who have studied Say's methods of description will understand why he places the description of *puncticollis* between *Galeruca externa* and *Trirhabda attennata*.

In regard to the forms described as *erosa*, *morosa* and *maritima*, no tangible difference seems to exist. The first was separated on account of its roughly punctured thorax, but a moderate series of specimens from various localities shows no difference. The other two were distinguished by the short hair of *maritima*, and somewhat longer hair in *morosa*. Here, too, the difference is imaginary, and depends rather on the method of collection than the specimens themselves.

**M. consputa** Lec., Pacif. R. R. Rep. Ins. p. 70; *guttulata* Lec., loc. cit.; *angularis* Proc. Acad. 1859, p. 90.—Form oblong, slightly oval, pale yellowish testaceous above and beneath, surface sparsely clothed with fine silken pubescence. Antennæ similar in color to the body, rarely slightly brownish, the fifth joint not shorter than the sixth. Head closely punctate. Thorax not quite twice as wide as long, narrower in front, widest between the basal angles, which are usually obtuse, sides feebly arcuate, base truncate at middle, oblique each side, disc uneven, a broad, but vague median depression, on each side a broad shallow fovea, sometimes obliquely placed; surface coarsely and moderately closely punctate, finely pubescent; elytra often entirely unicolorous, frequently with small black spots arranged in three indistinct series, surface closely punctate, a little more coarsely near the base, but becoming rapidly finer and denser toward the sides and apex. Body beneath closely punctate, the pubescence more conspicuous than above. Length .14—.18 inch.; 3.5—4.5 mm.

*Male.*—Claws finely bifid at tip; last ventral broadly emarginate, with a slight notch at middle prolonged into a short impression, simulating a fissure; pygidium convex and slightly inflexed at apex.

*Female.*—Claws simple; last ventral slightly broadly emarginate, with a well defined median impression the entire length of the segment, in the form of a deep, sharply defined gutter.

From the very large series before me this species seems the most constant in form and color of any known. It is always pale; the black spots, when present, small, and arranged in three fairly regular series. The next species often presents pale specimens resembling those of the present, that the mode of punctuation alone must be examined for their separation. The sexual characters are slightly different, but only a large series and experience can make use of this means.

Occurs in Montana, Dakota, Kansas, Colorado, Utah, Washington, Arizona and California.

**M. debilis** Lec., Proc. Acad. 1865, p. 222; *obtusa* Lec., loc. cit.—Very similar in form to *consputa*, but with a generally darker color, differing superficially in

having the elytral punctuation coarse over the entire surface, although a little finer toward the sides and apex. Length a little smaller on the average than the preceding species.

*Male.*—Claws bifid at apex, the inner portion a little shorter; last ventral segment vaguely emarginate from side to side with a slight median depression; pygidium slightly inflexed at apex.

*Female.*—Claws simple; last ventral less emarginate, with a slight notch at the middle of the edge, in front of which is a slight triangular depression.

Forms occur in this species as pale as any of those of *consputa*, but as a rule the color is darker and the black spots more numerous, forming three fairly marked lines with intermediate smaller spots irregularly placed. In the more decidedly maculate specimens the thorax often has a median dark stripe and a spot each side.

Occurs in Wyoming, Dakota, Utah, Oregon, California, Nevada, Arizona. In his description of *obtusa* LeConte gives Andover, Mass., as one of the localities. This is much more than doubtful.

**M. sordida** Lec., Proc. Acad. 1858, p. 88; loc. cit. 1865, p. 222.—Form oblong, similar to the preceding species, but a little more slender; color yellowish testaceous, the elytra with black spots of irregular size with a tendency to coalesce along the suture, rarely specimens occur with the surface entirely testaceous. Antennæ more or less brown. Head closely punctate, a finely impressed median line, surface finely pubescent. Thorax nearly twice as wide as long, not wider at base than apex, widest at middle, sides moderately arcuate, base truncate at middle, oblique each side, angles not prominent, disc irregular, a well-marked median sulcus, on each side two depressions, one near each angle; surface closely punctate, finely pubescent; elytra closely and rather coarsely punctate, finely pubescent, rarely entirely testaceous, usually with numerous black spots of irregular size. Body beneath brown or piceous, sparsely punctate or pubescent. Legs pale, sometimes the tibiæ and femora are banded at middle. Length .12—.14 inch.; 3—3.5 mm.

*Male.*—Claws finely bifid at tip. Last ventral truncate and broadly emarginate, with a slight depression near the margin.

*Female.*—Claws simple. Last ventral as truncate, with a slight emargination at the middle of the edge, from which proceeds a groove extending about one-third the length of the segment.

This species may be either entirely pale, or with spots which do not show the same tendency to form series. When the black spots are numerous they sometimes coalesce, forming larger spots placed at the umbone, each side of scutellum; an interrupted band in front of middle, oblique each side, another transverse, arcuate band one-third from the apex; often the entire suture is narrowly bordered with black.

This species may be known from either of the preceding by the thorax being not wider at base than at apex. The punctuation is a little finer than in *debilis*, but coarser than in *consputa*.

Occurs in New Mexico, Utah, Nevada, California and Arizona.

The genus *Monoxia*, as instituted by LeConte, contained merely the smaller species. He divided them primarily into two series from the form of the claws, which Crotch first recognized as merely sexual differences (Proc. Acad. 1873, p. 56).

While the arrangement above is not exactly in accord with Crotch's apportionment of the synonymy, the fact remains that three of LeConte's species are males and three females. Another character used by LeConte will be found to have but little value, and that is the oblique impression of the elytra. This may occur in either sex, but may be considered rather a male than a female characteristic. No mention has been made of it in the foregoing description.

### **TRIARIUS** Jacoby.

Head free, eyes oval, entire; labrum moderate in length, not emarginate; maxillary palpi not very stout, the last two joints nearly equal in length, the terminal conical. Antennæ slender. Thorax broader than long, slightly narrower at base than apex; scutellum oval at tip. Elytra oblong, parallel, the epipleuræ limited by a distinct marginal line and extending three-fourths to apex; prosternum very narrowly separating the coxæ, the cavities open behind, although very narrow in some specimens; metapleuræ moderate in width, parallel; ventral segments nearly equal in length, the fifth longer; femora moderately stout, tibiæ slender, but broader at tip; all the tibiæ with a well-developed spur; hind tarsi with the first joint not longer than the next two; claws bifid.

This genus was proposed for an insect (*T. mexicanus*) previously described by Dr. LeConte as *Phyllobrotica livida*. As correctly remarked by Mr. Jacoby, the armed tibiæ and the bifid claws forbid its entrance in the genus in which Dr. LeConte placed it. On the other hand I cannot agree with Mr. Jacoby that it has any special affinity with *Phyllobrotica*, the elytral epipleuræ being quite as well marked as in the vast majority of the members of the entire tribe. The relationship seems rather with *Diabrotica*, the only character of moment separating it being the separation of the front coxæ by the prosternum.

Two species are known to me:

Head with a distinct transverse depression between the eyes; color dull yellow; legs entirely yellow; elytra without ornamentation.....**lividus.**
Head without transverse depression; color yellow; elytra with piceous lines; legs in part piceous.....**trivittatus.**

**T. lividus** Lec. (*Phyllobrotica*), Trans. Am. Ent. Soc. xii, November, 1884, p. 28; *mexicanus* Jacoby, Biol. Cent.-Amer. vi, pt. 1, p. 571; id. Suppl, p. 335.—Oblong parallel, yellowish testaceous, often dull, head and thorax with a slight reddish tinge. Head smooth, a deep transverse frontal impression. Antennæ piceous, the three or four basal joints rufescent. Thorax one-fourth wider than long, slightly narrowed at base, sides feebly arcuate, the margin at front angles thickened, disc feebly convex, smooth. Elytra sparsely punctate, surface finely alutaceous. Body beneath with piceous metasternum, otherwise yellow. Legs entirely yellow. Length .16—.25 inch.; 4—6.5 mm.

*Male.*—Last ventral with a truncate lobe at middle, limited each side by a notch, disc of segment slightly concave; first joint of anterior tarsus distinctly dilated.

*Female.*—Last ventral broadly oval at tip; tarsi not dilated.

The sexual characters of the male are more nearly of the type of *Phyllobrotica* than to *Diabrotica*, to which latter the genus seems most closely related.

Occurs in Arizona south of Tucson.

**T. trivittatus** n. sp.—Form more slender and elongate than *lividus*, pale yellow, moderately shining, elytra with piceous vittæ. Head smooth, without impressed transverse line. Antennæ piceous, with three basal joints yellow. Thorax one-fourth wider than long, narrower at base, sides feebly arcuate, front angles slightly thickened, disc moderately convex, smooth. Elytra oblong, but little wider than the thorax; surface obsoletely finely punctate, color pale yellow, suture piceous, slightly broader behind, a basal piceous line, a vitta from the umbone nearly to the apex, a short vitta between this and the suture near the base, the side margin from the sutural angle nearly to base piceous; epipleuræ pale. Body beneath entirely yellow. Legs yellow, all the tarsi, the posterior tibiæ, and the outer edge of the front and middle tibiæ, piceous. Length .16—.24 inch.; 4—6 mm.

*Male.*—Last ventral segment with a moderately prolonged truncate middle lobe, limited each side by a notch, the disc of segment flat; first joint of anterior tarsus distinctly dilated.

*Female.*—As in *lividus*.

This insect looks not unlike *Luperus bivittatus*, with an addition of a short piceous line near the base. The five specimens before me are uniform in coloration. In this species some of the specimens have the anterior coxal cavities so nearly closed that a unique specimen might give rise to doubt as to its position.

Occurs in Arizona, Pinal Mountains (Wickham, 55).

**DIABROTICA** Chev.

Head not inserted as far as the eyes, front transversely impressed, vertex foveate, a carina between the antennæ. Eyes broadly oval, entire; labrum rather large, truncate, or feebly emarginate. Antennæ slender, at least longer than half the body, sometimes longer than the body, second and third joints often very small; maxillary palpi moderately stout, the terminal joint conical, shorter and narrower than the preceding. Thorax broader than long, sometimes nearly square, the margin distinct, slightly reflexed, disc usually bifoveate; scutellum acutely oval at tip. Elytra with a very distinct and slightly reflexed side margin, the epipleuræ distinct to apex; anterior coxæ contiguous, the prosternum with merely a linear prolongation, the cavities open behind; metasternal parapleuræ long, narrower behind. Legs moderately long and slender; tibiæ slender, the middle and posterior pairs with terminal spurs, the outer edge carinate from knee to tip, except in a few species; first joint of hind tarsus at least as long as the next two, sometimes nearly as long as the next three; claws bifid.

*Diabrotica* is, with few exceptions, confined to the Western Hemisphere, represented by many species of varied facies and ornamentation. It is the most numerously represented of all the Galerucide genera of our fauna.

All attempts to arrange the species have been based primarily on the structure of the antennæ with the result of completely confusing the species in their true relations to each other.

In the majority of the species the second and third joints are small, together scarcely as long as the fourth, sometimes only half as long; several species have the third joint nearly or quite as long as the fourth, while the second remains small. When the third joint is equal, or nearly so, to the fourth, it will be found to be densely punctured and pubescent like the fourth, but when that joint is small it will be found smooth and like the second in structure.

That some of the species have the tibiæ carinate, while in others it is not, seems not to have been observed by authors.

The male sexual characters are feeble. All have the last ventral truncate, and in some broadly emarginate. A few have the first joint of the anterior tarsi dilated.

Our species seem to divide naturally into three series, and may be determined by the aid of the annexed table:

Elytra irregularly, not closely punctate, the surface without striæ or sulci; tibiæ with a distinct carina extending the entire length of the outer edge.
Series A.

Elytra vaguely subsulcate, the punctures irregular and separated by smooth lines; tibiæ carinate (except in *vincta*), but less distinctly than in Series A.
Series B.

Elytra regularly sulcate-striate, the intervals very regularly elevated, the punctures arranged quite regularly in a double series in the sulci; tibiæ not at all carinate..... .Series C.

### Series A.

The species belonging to this series may be separated in the following manner:

Antennæ with third joint fully as long as the fourth and twice as long as second.
Elytra with a broad brown band at base, enclosing on each side an oval pale spot, emarginate at the side margin; four small round spots in an arcuate series at the posterior third.....**connexa.**
Elytra with three transverse black bands and a small apical spot, the second and third bands divided by the suture.....**tricincta.**

Antennæ with joints two and three small, together rarely longer than the fourth, usually shorter.
Elytra ornate, nearly as in *connexa*, but with the four posterior spots forming a crescent; joints nine and ten of antennæ conspicuously pale.
**picticornis.**
Elytra with three arcuately transverse series of black spots of four in each.
Entire underside of body and legs black.....**soror.**
Abdomen and base of femora pale.....**12-punctata.**
Elytra yellowish white, with three entire transverse bands of pale bluish green.....**balteata.**

### Series B.

The species of this series may be separated in the following manner:

Antennæ with joints two and three small, nearly equal, together much shorter than the fourth.....2.
Antennæ with joint third longer than second, and nearly or quite as long as the fourth.....3.

2.—Head and legs pale.....**longicornis.**
Head and legs in part piceous.
Abdomen and femora pale; elytra pale green, with short piceous vittæ at suture and from the umbone.....**virgifera.**
Abdomen and femora pale; elytra black, with the entire margin and apical space yellow; antennæ very long.....**filicornis.**
Abdomen and femora entirely black.
Elytra entirely black.....**atripennis.**
Elytra black, with the side margin and median vitta yellow.
**lemniscata.**

3.—Elytra pale, merely a slight fuscous area near the scutellum and humerus; legs pale.....**blandula.**
Elytra black, with a narrow side margin and a narrow vitta nearer the suture pale; legs black, except the base of femora.....**vincta.**

Series C.

This series contains but two species each with yellow elytra, with the black suture entire and a vitta from the umbone nearly to apex.

Antennæ entirely black; legs black, except the bases of the femora. **trivittata.**

Antennæ with three basal joints pale; middle and posterior legs pale, except knees and tarsi ..... **vittata.**

**D. connexa** Lec., Proc. Acad. 1865, p. 212; Jacoby, Biol. Cent.-Amer. vi, pt. 1, p. 549, pl. xxxii, fig. 20.--Oblong-oval, narrower in front, moderately convex, pale yellow, elytra with brown ornamentation; metasternum, tibiæ and tarsi piceous. Antennæ a little longer than half the body, slender, piceous, three basal joints pale, third joint slightly longer than the fourth and twice as long as the second. Head pale castaneous, smooth, clypeus sparsely punctate. Thorax wider than long, slightly narrower at apex, sides arcuate in front, sinuate behind the middle, disc moderately convex, sparsely obsoletely punctate. Elytra slightly broader behind the middle, sparsely finely punctate, a broad brown band occupying nearly the basal half of the elytra, the posterior border sinuous, at sides emarginate, not reaching the border of the elytra, enclosing on each side an oval pale spot of variable size, one-third from apex is an arcuate row of small brown spots, two on each side. Body beneath sparsely pubescent, abdomen finely punctulate; tibiæ with a well-marked carina on the outer edge extending from the knee to the apex. Length .28 inch.; 7 mm.

*Male.*—The last ventral segment is broadly truncate.

*Female.*--Last ventral slightly prolonged and oval at tip.

Very little variation has been observed in this species, the color of the head and the markings on the elytra may be lighter or darker, but never pass beyond the brown color.

Occurs in Texas and Mexico.

**D. picticornis** n. sp.—Form and somewhat like *connexa* in coloration. Antennæ slender, more than half the length of the body ,joints 1-3 pale, 4-8 piceous, 9-10 pale, 11 piceous, joints 2-3 small, the third a little longer, the two together a little longer than the fourth. Head black, smooth. Thorax broader than long, slightly narrower in front, sides anteriorly feebly arcuate, posteriorly slightly sinuate, disc convex, color slightly reddish, surface sparsely finely punctate. Elytra broader behind the middle, obsoletely punctate; yellow, with a broad piceous black band, similar in form to that of *connexa*, and a crescentic band one-third from apex. Abdomen very sparsely punctate, yellow; tibiæ carinate on the outer edge. Length .26 inch.; 6.5 mm.

*Male* not seen. The last ventral of female oval at tip.

This species bears a deceptive resemblance to *connexa*, and might readily be thought a variety of it, but the form of the second and third joints of the antennæ, together with the arrangement of the colors of the joints, will at once distinguish it.

Occurs in Texas, locality unknown.

**D. tricincta** Say, Journ. Acad. iii, p. 457; ed. Lec. ii, p. 221; *suffriani* Jacoby, Biol. Cent.-Amer. vi, pt. 1, p. 551, pl. xxxii, fig. 3.—Form oblong, feebly convex, color yellow; head, metasternum, tibiæ and tarsi black, elytra with three transverse bands and a small apical spot black. Antennæ piceous, two basal joints paler. Head impunctate. Thorax very little wider than long, slightly narrowed in front, sides anteriorly feebly arcuate, then slightly sinuate to base, anterior angles slightly prominent, disc convex, smooth. Elytra sparsely punctate, yellow, with three transverse bands which do not attain the side margin, the basal band crosses the suture and sends a short branch backward, the second and third bands are interrupted by the suture, the apical spot is small and at the sutural angle. Abdomen yellow, sparsely pubescent, finely punctate; tibiæ carinate on the outer edge. Length .22—.26 inch.; 5.5—6.5 mm.

*Male.*—Last ventral truncate and broadly emarginate; first joint of front tarsi dilated.

*Female.*—Last ventral narrowly oval at tip.

Occurs from Colorado southward to Arizona, extending into Mex.

**D. duodecimpunctata** Fab., Syst. Ent. p. 103; Oliv., Ent. vi, p. 628, pl. 2, fig. 31; *tenella* Lec., Proc. Acad. 1858, p. 58.—Oblong-oval, narrower in front, moderately convex, pale yellowish green, each elytron with six piceous black spots of variable size. Antennæ slender, longer than half the body, piceous, three basal joints pale, joints 2-3 small, the third the longer, the two together about as long as the fourth. Head black, smooth, vertical impression deep. Thorax wider than long, slightly narrower in front, sides slightly arcuate anteriorly, then feebly sinuate; disc convex, with a moderately deep fovea each side of middle, surface smooth; scutellum piceous. Elytra wider behind the middle, sparsely obsoletely punctate; color yellow, with a slight tinge of green, on each side of the scutellum an oblong spot obliquely placed, another oblong spot on umbone; at middle two spots placed slightly obliquely, one-third from apex two spots more obliquely placed; metasternum piceous. Abdomen yellow, sparsely punctate; tibiæ distinctly carinate on the outer side. Legs piceous, the basal half of the femora pale.

*Male.*—Last ventral truncate and broadly emarginate; front tarsi not dilated.

*Female.*—Last ventral narrowly oval at tip.

This species does not vary greatly from a normal standard. Specimens are occasionally seen in which the spots show a tendency to elongate and unite in a longitudinal direction.

Var. *tenella* Lec.—This name was suggested for those forms in which the spots are reduced to a very small size, and in which the posterior series may be entirely lost. In this variety the antennæ are usually paler, and the femora are more than half pale.

This species occurs over the entire eastern region from Canada southward to Texas, extending into Arizona, and even to southern California. It doubtless occurs in Mexico also. The variety *tenella* occurs only in the extreme southwest.

**D. soror** Lec., Proc. Acad. 1865, p. 212; 12-*punctata* ‡ var. Mann., Bull. Mosc. 1843, p. 309.

This species resembles 12-*punctata* in so many ways that a full description is hardly necessary. The following are the distinctive points: Antennæ almost entirely piceous, the basal three joints merely slightly paler. Thorax less transverse, entire body beneath and legs black; the size is usually less than in 12-*punctata*. The sexual characters are the same.

As a rule the piceous spots on the elytra are larger than in 12-*punctata*, and have more of a tendency to become confluent and in a transverse direction, although specimens are not rare in which the humeral spot is prolonged to the next series of spots. The spot near the scutellum is confluent with its fellow, the two forming a quadrate spot.

At this time the query may be proposed as to whether 12-*notata* Harold is not related to *soror* in the manner that *tenella* is to 12-*punctata*.

Occurs from Oregon southward through California to Arizona, and probably Mexico.

**D. balteata** Lec., Proc. Acad. 1865, p. 213; Jacoby, Biol. Cent.-Amer. vi, pt. i, p. 530, pl. xxix, fig. 23; *sallei* Baly, Journ. Linn. Soc. Zool. xix, p. 227.—Form very like 12-*punctata*. Antennæ piceous, three basal joints paler, joints 2–3 small, the third slightly the longer, the two together about equal to the fourth. Head rufescent, smooth, a deep vertical fovea. Thorax pale yellow, or slightly greenish, broader than long, slightly narrower in front, sides slightly arcuate anteriorly, feebly sinuate thence to base; disc moderately convex, smooth, with a fovea each side variable in extent; scutellum piceous. Elytra broader behind the middle, moderately closely but obsoletely punctate; color very pale malachite green with yellowish white spaces as follows: the lateral margin narrowly nearly to apex, an oval subhumeral spot, a larger oval spot near scutellum, two slightly arcuate bands which do not attain the margin or suture, one before and one behind the middle, an ill-defined spot near apex; entire body beneath pale yellow, except metasternum, tibiæ and tarsi, which are piceous; tibiæ distinctly carinate. Length .20—.24 inch.; 5—6 mm.

*Male.*—Last ventral truncate and broadly emarginate; tarsi not dilated.

*Female.*—Last ventral narrowly oval at tip.

The above description has been drawn from specimens in perfect condition. The color of the elytra is, however, so dilated that it soon fades by too long preservation in spirit or from exposure to light. The color then becomes a dull yellowish white, in which, however, traces of the paler bands may usually be seen on close examination.

The only variation observed is in the tendency of the antennæ to become ferruginous.

Occurs from Texas southward through Mexico to Columbia, S. A.

**D. longicornis** Say, Journ. Acad. iii, p. 460; ed. Lec. ii, p. 223.—Oblong, moderately elongate, entire body and legs yellowish white, or with a slight tinge of green. Antennæ slender, longer than half the body, pale brown or ferruginous, joints 2–3 small, the third a little longer, the two together not longer than the fourth. Head smooth, vertical fovea not deep. Thorax a little wider than long, sides arcuate in front, slightly sinuate posteriorly, disc convex, with a moderately deep fovea each side, surface smooth. Elytra distinctly wider behind the middle, surface moderately coarsely and closely punctate, disc vaguely subsulcate, and with a costiform elevation from the umbone two-third to apex. Abdomen very sparsely punctate; tibiæ distinctly carinate. Length .20—.22 inch.; 5—5.5 mm.

*Male.*—Last ventral truncate and slightly emarginate; first joint of anterior tarsi dilated.

*Female.*—Last ventral narrowly oval at tip; tarsi not dilated.

No variations have been observed. This is the only species in our fauna in which the entire body and legs are uniformly pale.

Occurs from the Middle States westward to Kansas.

**D. virgifera** Lec., Trans. Am. Ent. Soc. 1868, p. 59.—Oblong, nearly parallel, pale yellow head; metasternum, tibiæ and tarsi black. Antennæ black, three basal joints testaceous, joints 2–3 small, together but little longer than half the fourth. Head smooth, vertical fovea moderately deep. Thorax very nearly as long as wide, not narrowed in front, sides slightly sinuate behind the middle, disc smooth, bifoveate; scutellum piceous. Elytra nearly parallel, moderately closely punctate, smoother near the apex, surface vaguely subsulcate, with an obtuse costa from the umbone three-fourths to apex; color pale yellow, or with a slight greenish tinge, a narrow, sutural, piceous vitta, and one from each umbone extending three-fourths to apex. Abdomen yellow, obsoletely punctate; tibiæ and tarsi black, femora yellow, sometimes with an upper line piceous. Length .20—.24 inch.; 5—6 mm.

*Male.*—Last ventral segment truncate; tarsi not dilated.

*Female.*—Last ventral oval at tip.

The type described by LeConte, as well as my own, have doubtless been decolored by immersion in alcohol. More recent specimens show that the true color is slightly green. The sutural and lateral vittæ are apt to be much reduced in extent. While the second and third joints are usually small and scarcely longer together than half the fourth, one specimen has these two nearly equal to the fourth.

Occurs at Fort Wallace, N. Mex., southern Arizona and northern Sonora.

**D. filicornis** n. sp.—Oblong, similar in form to *vittata*, color piceous black; thorax, side margin, and apex of elytra and abdomen yellow. Antennæ slender,

a little longer than the body, piceous; second and third joints small, a little longer than half the fourth. Head piceous, smooth, vertical impression moderate. Thorax nearly as long as wide, sides slightly arcuate in front and feebly sinuate posteriorly, disc smooth, vaguely bifoveate. Elytra sparsely punctate, smoother at base and apex, vaguely subsulcate, and with an obtuse carina from umbone three-fourths to apex; color piceous black shining, the margin yellow, expanding to a spot at apex; femora yellow, with the upper edge piceous, anterior and middle tibiæ piceous externally, yellow on inner side, posterior tibiæ and all the tarsi, piceous. Length .20 inch.; 5 mm.

*Male.*—Last ventral truncate; first joint of front tarsus dilated and thickened.

*Female.*—Last ventral oval at tip.

In one specimen before me there is an indefinite yellow spot on each side of the suture near the base, as if varieties of the species might occur with trivittate elytra as in *vittata.*

This species is peculiar among those in our fauna in having the antennæ longer than the entire body.

Occurs in New Mexico, special locality unknown (Schaupp).

**D. atripennis** Say, Journ. Acad. iii, p. 461; ed. Lec. ii, p. 224: *cristata* Harris, Trans. Hartf. Nat. Hist. Soc. p. 90; *fossata* Lec., Proc. Acad. 1858, p. 88. —Oblong-oval, narrower in front, either entirely black, or with the thorax and abdomen yellow. Antennæ three-fourths the length of the body, black; joints 2-3 small, nodiform, together scarcely longer than half the fourth. Head smooth, vertical fovea feeble. Thorax broader than long, sides arcuate in front, sinuate posteriorly, disc smooth, bifoveate. Elytra obsoletely sparsely punctate, vaguely subsulcate, with an obtuse carina from the umbone three-fourths to apex; tibiæ distinctly carinate. Length .15—.20 inch.; 4—5 mm.

*Male.*—Last ventral truncate and broadly emarginate; first joint of front tarsus slightly broader and thicker.

*Female.*—Last ventral oval at tip.

Var. **atripennis** Say.—Thorax and abdomen yellow.

Var. **crestata** Harris.—Thorax yellow, with a median stripe black. Abdomen black.

Var. **fossata** Lec.—Entirely black.

A rather common species distributed from Massachusetts to Dakota, Kansas and Texas.

**D. lemniscata** Lec., Trans. Am. Ent. Soc. ii, 1868, p. 58.—Form elongate, parallel, piceous black, shining, each elytron with the side margin and a vitta yellow. Antennæ piceous, three-fourths the length of body, joints 2-3 small, together not as long as the fourth. Head smooth, vertical fovea moderate. Thorax a little wider than long, sides arcuate in front, slightly sinuate posteriorly, disc smooth, bifoveate. Elytra sparsely and indistinctly punctulate and alutaceous; disc very vaguely subsulcate, an obtuse plica from umbone toward apex. Body beneath and legs entirely black; tibiæ distinctly carinate. Length .20—.24 inch.; 5—6 mm.

*Male.*—Last ventral truncate and broadly emarginate; first joint of anterior tarsus slightly thickened.

*Female.*—Last ventral broadly oval at tip.

Very little variation has been observed, except in one specimen, in which the middle vitta tends to disappear.

Occurs near the Raton Mountains and at Fort Union, N. Mex.

**D. blandula** Lec., Trans, Am. Ent. Soc. ii, 1868, p. 58.—Oval, oblong, yellowish white, head and metasternum piceous. Antennæ brown, paler at base, nearly three-fourths the length of body, joint 2 small, 3 nearly as long as four. Head smooth, vertical fovea feeble. Thorax one-third wider than long. Head smooth, vertical fovea feeble. Thorax one-third wider than long, sides slightly arcuate in front, feebly sinuate posteriorly, disc smooth, with two vague fovea, which tend to meet posteriorly. Elytra sparsely punctate, distinctly subsulcate, the humeral carina feeble, color pale yellow, with a short brownish vitta from the scutellum and from the umbone. Abdomen nearly smooth. Legs pale yellow, tarsi piceous; posterior tibiæ carinate near base only. Length .20 inch.; 5 mm.

*Male.*—Last ventral truncate.

*Female.*—Unknown.

This species resembles *virgifera* in color and markings, but may be known by the structure of the antennæ, the broader thorax and color of the legs.

Occurs near the Smoky Hill River, New Mexico.

**D. vincta** Lec., Proc. Amer. Philos. Soc. xvii, 1878, p. 416.—Oblong oval, form of *vittata*, above black, thorax yellow, elytra with the side margin and an entire median vitta yellowish white. Antennæ three-fourths the length of the body, piceous; joint two small, the third nearly as long as the fourth. Head black, smooth, vertical fovea small. Thorax slightly wider than long, sides feebly arcuate in front, slightly oblique behind, disc smooth, bifoveate; scutellum black. Elytra rather coarsely and closely punctate, the surface vaguely subsulcate, the humeral carina not present, color black, side margin to suture and a vitta from base to apex ivory-white; metasternum piceous, abdomen and base of femora yellow. Legs otherwise black; tibiæ carinate near the base only. Length .16—.18 inch.; 4—4.5 mm.

The only specimen before me is a female having the broadly oval apex to the last ventral segment.

The median vitta on each elytron resemble the so-called ivory vitta seen in many Cerambycidæ.

Occurs in Georgia and Florida at Capron.

**D. vittata** Fab., Syst. Ent. p. 122; *melanocephala* Fab., loc. cit. p. 118; Oliv., Enc. Meth. vi, p. 590; Ent. vi, p. 633, pl. 3, fig. 38; *americana* Gmelin, ed. Linn. i, 4, p. 1715; *stolata* Gmel., loc. cit. p. 1724.—Oblong-oval, pale yellow above; head, a sutural and humeral vitta on each elytron black. Antennæ more than half the length of the body, the three basal joints partly pale, joint two small, the third nearly as long as the fourth. Head black, smooth, ventral fovea rather large. Thorax one-fourth wider than long, sides arcuate in front, slightly sinuate posteriorly, disc deeply bifoveate; scutellum black. Elytra slightly oval,

surface rather broadly striate, striæ biseriately punctate, intervals convex, subcostiform, color pale yellow, a sutural black vitta occupying two intervals extending from base to apex, a humeral vitta nearly reaching the apex on the intervals 6–8. Body beneath piceous. Legs yellow, the knees, the anterior tibiæ and tarsi and the tips of the middle and posterior tibiæ and their tarsi piceous; tibiæ without trace of carina. Length .18—.24 inch.; 4.5—6 mm.

*Male.*—Last ventral truncate and feebly emarginate; tarsi not dilated.

*Female.*—Last ventral oval at tip.

This species is remarkably constant in its characters for one so widely diffused.

Abundant over the entire eastern United States from Canada southward.

**D. trivittata** Mann., Bull. Mosc. 1843, p. 309.

Very closely resembling *vittata*, differing in the following particulars:

Antennæ entirely piceous. Thorax bifoveate, the two foveæ coalescing posteriorly. Legs entirely black, except the bases of the femora.

*Male.*—Last ventral feebly truncate, slightly emarginate; first joint of front and middle tarsi distinctly broader and thicker.

*Female.*—Last ventral oval at tip; tarsi not dilated.

This species occurs throughout California, where it replaces *vittata* of the Eastern States.

*D. amœnula* and *D. octonotata* described by Boheman, and placed doubtfully in our lists, are from the Pacific islands, and do not occur in our fauna.

### PHYLLOBROTICA Redt.

Head free, transversely grooved between the eyes. Eyes nearly round, prominent; labrum short, feebly emarginate; maxillary palpi not stout, the third and fourth joints obconical, the latter smaller and acute at tip. Antennæ slender, longer and more slender in the female, first joint stout, second and third usually shorter, the third longer than the second, four to eleven nearly equal in length. Thorax transversely quadrate, sides nearly straight, disc usually with depressions; scutellum oval at tip. Elytra parallel, without lateral margin and without separate epipleuræ; prosternum obliterated between coxæ, the cavities open behind; metasternal parapleuræ rather wide and parallel; ventral segments one to four equal in length, fifth much longer. Legs rather slender, tibiæ without spurs; first joint of hind tarsus scarcely as long as the next two, claws appendiculate and divaricate.

This genus is very properly separated from all the others with open front coxal cavities and appendiculate claws by the entire absence of epipleuræ in so far as these are defined by the acute lateral margin of the elytra. It seems to me that this genus alone should constitute the group of Phyllobroticites, and that *Phyllecthrus* should be removed, reasons for which are given under that genus.

There are now eight species known to me, five belonging to the Atlantic region and three to the Pacific, the former having ornate elytra, the latter blue or greenish.

They may be known by the characters given in the following table:

Legs pale or bicolored.
Thorax yellow.
Elytra bicolored, maculate, vittate or margined.
Head entirely yellow.
Elytra yellow, with two oval piceous spots on each.....**decorata.**
Elytra piceous, with suture and sides yellow.
Elytra with elevated costæ and punctate.....**costipennis.**
Elytra not costate.
Thorax with a moderately deep fovea each side.....**discoidea.**
Thorax with a transverse depression.....**limbata.**
Head black, front pale; each elytron with an intermediate pale vitta.
**vittata.**
Elytra uniform, blue or greenish.....**viridipennis.**
Thorax black, elytra dull blue or greenish.....**luperina.**
Legs entirely black.
Head, thorax and body black, elytra dull blue.....**nigripes.**

**P. decorata** Say, Journ. Acad. iii, p. 459; ed. Lec. ii, p. 203; *Olivieri* Kby., Fauna Am. Bor. iv, p. 218.—Form elongate, parallel. Head black, front yellow, impunctate. Antennæ piceous, the three basal joints yellow. Thorax broader than long, sides slightly sinuate, disc smooth, color yellow. Elytra yellow, on each two oval piceous spots, one at base smaller, and one behind the middle, oblong; surface not distinctly punctate. Body beneath piceous black, with a few sparsely placed punctures. Legs entirely yellow. Length .22—.28 inch.; 5.5—7 mm.

In the male the last ventral segment is large, canaliculate in front, broadly concave near the apex, the apical margin bisinuate. The last dorsal is deeply semicircularly emarginate; posterior tibiæ arcuate; the last ventral of the female is not concave, the apex oval.

Very little variation has been observed in this species. There is, however, in Mr. Ulke's cabinet one female in which the two spots unite and form a vitta, as in *discoidea*, but, from the fact that the thorax is very evenly convex, I incline to consider it a variety of the present species. Its size prevents it from being considered *circumdata*.

Occurs in the Lake Superior region, Illinois and Colorado.

**P. costipennis** n. sp.—Form of *discoidea;* head and thorax yellow, elytra black, with the entire limb and suture narrowly yellow. Antennæ entirely black. Head smooth. Thorax wider than long, sides slightly arcuate in front, straight and convergent behind, disc smooth, on each side of middle a large, but shallow fovea. Elytra with the suture elevated and four distinct discal costæ, between which the surface is distinctly punctate. Body beneath yellow, abdomen piceous, sparsely finely punctate; femora yellow, tibiæ in greater part and tarsi piceous. Length .24—.28 inch.; 6—7 mm.

In the male the segments 2–3–4 are short, and have a slight gibbosity on the median line. The last ventral is very large, convex, with a shallow median depression, and at middle of apex a short oval lobe limited each side by a sinuation. The last dorsal is truncate and broadly emarginate. The female ventral segments are of normal structure.

This species may be readily known by the costate elytra. The male sexual characters resemble those of *discoidea.*

Occurs in Georgia and Florida.

**P. discoidea** Fab., Syst. El. i, p. 485; *circumdata* Say, Journ. Acad. iii, p. 457; edit. Lec. ii, p. 221.—Form of *decorata.* Head smooth, yellow. Antennæ black, the three basal joints often paler, but not conspicuously so. Thorax wider than long, slightly wider at apex, sides slightly sinuate, disc smooth, a moderately deep foveiform depression each side of middle. Elytra piceous black, with the base, suture and side margin yellow, surface sparsely punctate, and in the females vaguely subcostate. Body beneath yellow varying to brownish. Legs yellow, tips of tibiæ and tarsi piceous. Length .14—.26 inch.; 3 5—6.5 mm.

In the male the third and fourth segments of the abdomen are short, together but little longer than the second; the last ventral is large, convex, a slight median depression, the apex bisinuate. The last dorsal is emarginate at middle and on each side ciliate. In the female the segments 2–3–4 are gradually shorter, the fifth oval at tip, the last dorsal entire.

No variations worthy of note have been observed.

It is very clear that Dr. LeConte and others have confused three species under the name *discoidea*, the present species, *limbata*, and another which he mentions as a curious color variety. That Fabricius clearly differentiated his two species is very evident from his mention of the black antennæ and the bifoveate thorax of the present species. Say's synonym has been fixed by the antennæ. The male sexual characters separate the two beyond all doubt. In the present species it will be observed that the elytra are a little less shining from the more evident punctuation.

Occurs in Virginia, North Carolina and Georgia.

**P. limbata** Fab., Syst. El. 1, p. 486.—Form of *discoidea*, and closely resembling it in coloration. Antennæ piceous, the three basal joints conspicuously paler. Thorax also similar in form, but with a transverse depression of somewhat crescentic form, sometimes slightly deeper at the ends. Elytra very indistinctly punctate and quite shining. Body beneath entirely yellow, the abdomen sometimes slightly darker. Legs yellow, sometimes with the tips of the tibiæ and tarsi darker. Length .14—.26 inch.; 3.5—6.5 mm.

In the male the segments 2–3–4 are not very different in length, being successively slightly shorter. The last segment is large, the disc in front convex, near apex a deep fovea, beyond which the segment is prolonged in a truncate lobe limited each side by a deep notch. Last dorsal segment truncate, slightly emarginate, ciliate on its edge. In the female the terminal ventral segment is oval, the pygidium oval, but more acute.

This species resembles *discoidea* so greatly superficially, that it is not surprising that it has not been separated. It will be observed that the thorax has a vague transverse depression in place of two foveæ, the antennæ are shorter and stouter, sex for sex, than in *discoidea*, the elytra smoother and more shining. The structure of the last ventral of the male is notably different.

As a rule, the three basal joints of the antennæ are conspicuously paler, while in *discoidea*, usually piceous. In the present species the abdomen is yellow, and in *discoidea* usually more or less piceous. While the legs here are usually all yellow, it is the rule in *discoidea* to have the tips of tibiæ and tarsi piceous.

Occurs in District of Columbia, Virginia, Iowa, Texas.

**P. vittata** n. sp.—Form of *discoidea*. Head black, shining, front yellow. Antennæ piceous, basal joint sometimes pale. Thorax yellow, one-half wider than long, sides nearly straight, slightly convergent posteriorly, disc smooth, a vague transverse depression of variable extent. Elytra piceous, side margin and suture yellow, and a similar vitta of variable extent from the humeri to apex, surface either quite smooth ♂, or sparsely finely punctate ♀. Body beneath yellow, abdomen usually piceous, sometimes yellow. Legs yellow, tibiæ at apex and tarsi piceous. Length .16—.20 inch.; 4—5 mm.

In the male the ventral segments 2–3–4 are nearly equal in length, the fifth much larger, convex in front, very deeply cupuliform behind, at middle prolonged in a short truncate lobe limited each side by a notch; the last dorsal is truncate and ciliate. The ventral segments of the female are as in *limbata*.

In the female the antennæ are of the usual filiform structure, while in the male they are evidently thicker toward the tip.

This species is founded on the "singularly-colored specimen" mentioned by Dr. LeConte. It varies somewhat in its markings. In two specimens before me ♂ ♀, the humeral is short and slender, not reaching the apex, while in two others the vitta is broad and entire. In three specimens the abdomen is brown or piceous, in one pale yellow. The form of thorax is that of *limbata*, and the male sexual characters nearly so, but the depression of the last ventral is much deeper.

Occurs in Pennsylvania, North Carolina and Georgia.

**P. viridipennis** Lec., Proc. Acad. 1859, p. 81; loc. cit. 1865, p. 207.—Similar in form to *discoidea*, but less elongate. Antennæ often entirely yellow, usually with the outer joints darker. Head yellow, with an occipital piceous spot of variable size, usually sparsely finely punctate. Thorax wider than long, sides slightly arcuate in front, straight and convergent posteriorly, disc smooth, with a fovea on each side of variable extent. Elytra violet-blue or slightly greenish, sparsely finely punctate. Body beneath entirely piceous. Legs yellow. Length .20—.26 inch.; 5—6.5 mm.

In the male the ventral segments 2–3–4 are gradually shorter, the fifth large, with a deep oval excavation nearly the length of the segment, the apex of the segment deeply emarginate, with a slight lobe in the emargination, the last dorsal narrowed at apex and truncate. Ventrals of female normal.

The style of coloration will enable this species to be known from any other in our fauna. No striking variations have been observed.

Occurs in California and Nevada.

**P. luperina** Lec., Proc. Acad. 1865, p. 207.—Form slightly more robust than *viridipennis;* head and thorax black, shining; elytra blue or slightly greenish. Antennæ piceous externally, the basal five joints yellow. Head black, sparsely punctate, front yellow. Thorax wider than long, sides nearly straight and slightly convergent to base, surface sparsely finely punctate, and on each side a fovea, these sometimes united by a vague transverse depression; surface sparsely, finely and indistinctly punctate. Body beneath entirely black. Legs yellow, tips of tibiæ and tarsi slightly darker. Length .20—.26 inch.; 5—6.5 mm.

In the male the ventral segments 2–3–4 are gradually shorter, the fifth large and with a large and deep oval excavation, the apex of the segment emarginate, with a feeble median lobe, the last dorsal is truncate and slightly emarginate. The ventrals of the female are of normal structure.

Occurs in California south of San Francisco; at San Mateo and Santa Barbara.

**P. nigripes** n. sp.—Form of *luperina*, black, shining; elytra dull blue or greenish. Antennæ entirely black. Head with few scattered fine punctures. Thorax one-fourth wider than long, sides nearly straight, slightly convergent to base, disc feebly convex, a broad but vague oblique depression each side, the two uniting at middle, surface vaguely punctate. Elytra finely alutaceous, punctate, smoother near apex. Body beneath black, shining, sparsely punctate. Legs entirely black. Length .20 inch.; 5 mm.

The male has the segments 2–3–4 of the abdomen gradually shorter, the fifth large, with a broad and deep groove running its entire length. The last dorsal is oval at tip. In the female the segments are of normal form.

This species is the only one in our fauna with totally black legs. Its resemblance to *Haltica bimarginata* is so deceptive, that the two individuals in my cabinet were sent with specimens of that species.

Occurs at Los Angeles, Cal. (D. W. Coquillett).

### SCELOLYPERUS Crotch.

Antennæ slender, longer than half the body, second joint shorter than the third. Elytra with distinct edge separating the epipleuræ, the latter nearly reaching the apex of the elytra; last joint of maxillary palpus obtusely conical, slightly longer than the preceding joint, and as wide at base; anterior coxæ contiguous; tibiæ without spurs; first joint of hind tarsus nearly as long as the following joints united; claws broadly appendiculate at base.

The species of this genus are of graceful form, moderately elongate, slightly depressed, the legs rather long. The antennæ are similar in the sexes.

In the males of all the species the last ventral segment is nearly as long as the three preceding joints, the apex very obtuse, the surface flattened and slightly concave along the apex. The last ventral of the female is about as long as the two preceding, acutely oval at tip.

Our species of this genus have been heretofore placed in *Luperus*, from which they differ in the absence of tibial spurs. They are larger than *Luperus*, and of quite different facies, and have always seemed out of place in association with them.

On an examination of Crotch's type I cannot find that there is any reason why the species subsequently described as *Scelida* should not be united with it. The character which seems to have attracted Crotch's attention, and which probably induced him to separate the genus, is the presence of a strong tooth on the inner edge of the

curved tibiæ near the knee. There will, however, be found in the annexed table two species with curved hind tibiæ in the male which are certainly not separable from *Scelida*, while Crotch's type differs from those in the single sexual character of a tooth on the curved tibiæ. While the description of *Scelolyperus* is rather meagre, the presence of the type makes it necessary to suppress *Scelida*.

All our species belong to the Pacific faunal region and occur in Oregon, California and Arizona, one species extending to Montana and Colorado. They may be separated as follows:

Thorax always entirely yellow.
Head and femora yellow ..... **flaviceps.**
Head metallic green.
Elytra finely sparsely punctate, smoother at apex, posterior tibiæ ♂ straight and not toothed ..... **flavicollis.**
Elytra coarsely sparsely punctate; posterior tibiæ ♂ stout, arcuate and toothed at base ..... **tejonicus.**
Elytra sparsely punctate and alutaceous; posterior tibiæ ♂ strongly curved, not toothed ..... **loripes.**
Thorax either maculate or blue, varying to black.
Thorax yellowish, with a median and lateral spot piceous.... **maculicollis.**
Thorax uniformly blue or black.
Elytra evidently punctate.
Thorax polished, impunctate, black, slightly narrowed to base. **maculicollis** var.
Thorax sparsely punctate.
Antennæ and legs black; posterior tibiæ of male straight. **graptoderoides.**
Antennæ at base, anterior femora and tibiæ in part yellow; posterior tibiæ ♂ curved ..... **Schwarzi.**
Elytra alutaceous, not punctate.
Antennæ filiform, last joint scarcely longer than the preceding. **longulus.**
Antennæ broader externally, the outer joints flattened and slightly concave beneath in ♂, last joint notably longer ..... **decipiens.**

**S. flaviceps** n. sp.—Similar in form to *flavicollis*, but a little more robust; head, thorax, metasternum and femora yellow, elytra metallic-green or blue in certain lights. Antennæ two-thirds the length of body, piceous, the underside of the three basal joints pale. Head smooth, yellow. Thorax broader than long, slightly narrower at apex than at base, sides slightly arcuate in front, parallel posteriorly, disc moderately convex, smooth and impunctate; scutellum yellow. Elytra with slightly arcuate sides, surface rather polished, sparsely finely punctate; metasternum and abdomen piceous, with bluish lustre; femora reddish yellow, tipped with piceous at the knees, the tibiæ and tarsi black. Length .26 inch.; 6.5 mm.

Two female specimens have been examined, their ventral characters the same as in *flavicollis*.

This species seems to resemble *metallica* Jacoby, as figured in Biol. Cent.-Amer. vi, pt. 1, pl. xxxiii, fig. 10, but the color of the legs will easily distinguish the two.

Occurs in Arizona, special region unknown.

**S. flavicollis** Lec. (*Phyllobrotica*), Proc. Acad. 1859, p. 81; Lec. (*Luperus*), Proc. Acad. 1865, p. 209.—Form oblong, parallel, above blue or green, metallic, thorax yellow, legs piceous. Antennæ two-thirds the length of the body, piceous, the three basal joints bicolored. Head metallic-green, impunctate. Thorax yellow, broader than long, slightly narrower in front, sides feebly arcuate, disc convex, smooth, impunctate. Elytra with feebly arcuate sides, disc sparsely finely punctate, less distinctly at apex, surface metallic-green or blue, distinctly alutaceous. Body beneath and legs piceous, with distinct greenish surface. Length .26—.28 inch.; 6.5—7 mm.

*Male.*—Last ventral truncate at middle, a slight sinuation each side, disc flattened.

*Female.*—Last ventral rather densely prolonged.

Occurs at Fort Tejon and other places in southern California.

**S. tejonicus** Crotch, Trans. Am. Ent. Soc. 1874, p. 79.—Oblong, parallel, moderately convex, glabrous, shining; body beneath and legs, black; antennæ at base pale, head and elytra blue. Head smooth, carinate between the antennæ. Thorax quadrangular, slightly broader than long and somewhat narrowed in front, sides slightly arcuate anteriorly, disc slightly convex, with impunctate surface. Elytra coarsely sparsely punctate. Body beneath very sparsely pubescent. Length .20 inch.; 5 mm.

*Male.*—Last ventral segment truncate and sinuate at apex, the disc slightly concave; middle tibiæ slightly, posterior strongly arcuate, and with a strong tooth on the inner edge near the knee.

The female is unknown.

The structure of the posterior tibiæ is rather remarkable, no such structure having been noticed in any of the hitherto described species.

One specimen collected at Fort Tejon, Cal.

**S. loripes** n. sp.—Oblong, parallel, beneath piceous, head and elytra metallic-blue, thorax yellowish. Antennæ piceous, the basal four joints pale on the underside. Head alutaceous, impunctate. Thorax a little wider than long, slightly narrowed in front, sides very feebly arcuate, disc very indistinctly alutaceous, with very minute, sparse punctures, larger along the base. Elytra distinctly alutaceous, punctuation not large nor close, smoother toward apex. Body beneath very sparsely pubescent. Legs piceous, the anterior femora at knees, their tibiæ in great part, yellow. Length .20 inch.; 5 mm.

*Male.*—Last ventral transversely concave, the apex vaguely emarginate; posterior tibiæ stout, arcuate.

This species might readily be mistaken for a small *flavicollis*, which it resembles in form and color, although more distinctly punctate. As females of *loripes* are unknown, the only differential character must be drawn from the hind tibiæ of the male.

Occurs in California, probably northern.

**S. maculicollis** Lec. (*Luperus*), Trans. Am. Ent. Soc. xii, p. 27.—Oblong, parallel, beneath and legs piceous; above, head black; thorax either yellow with piceous spots or entirely black, elytra bluish or greenish. Antennæ two-thirds the length of the body, piceous; the three basal joints pale beneath. Head smooth, black. Thorax broader than long, sides slightly arcuate in front, then divergent to base; disc slightly convex, polished in the black specimens, or with a very few punctures in the maculate; scutellum black. Elytra moderately closely punctate, not alutaceous, in some specimens vaguely subsulcate. Length .24—.28 inch.; 6—7 mm.

*Male.*—Last ventral semicircularly emarginate at middle, truncate each side.

*Female*—Last ventral broadly oval at tip.

Two varieties occur in this species between which all necessary intermediate forms are in my cabinet.

In the typical form the thorax is yellow, with an oblong-oval, piceous spot, broader in front, on the median line, and a smaller piceous spot on each side near margin. In the other form the thorax is polished black.

Occurs at San Diego, Cal.

**S. graptoderoides** Crotch (*Luperus*), Trans. Am. Ent. Soc. 1874, p. 80.—Form of *flavicollis;* head and thorax greenish blue, elytra cobalt-blue, body beneath and legs piceous, with distinct bluish tinge. Antennæ two-thirds the length of the body, piceous; the three basal joints paler beneath. Head smooth. Thorax slightly wider than long, a little narrower at apex, sides feebly arcuate in front, then parallel to base, disc moderately convex, sparsely finely punctate; scutellum blue-black. Elytra sparsely, but very distinctly punctate, surface alutaceous. Body beneath and legs piceous, with bluish lustre. Length .26—.28 inch.; 6.5—7 mm.

*Male.*—The ventral characters are as in *flavicollis*; the first joint of front tarsus slightly dilated and thickened.

*Female.*—As in *flavicollis.*

Occurs at Santa Barbara, San Buenaventina and Los Angeles (Cal.).

**S. Schwarzii** n. sp.—Form oblong, parallel, beneath piceous, above uniformly blue, greenish or bronze. Antennæ piceous, the basal four joints in great part testaceous. Head alutaceous, sparsely punctate near the eyes. Thorax a little wider than long, slightly narrower in front, sides anteriorly feebly arcuate, then feebly sinuous to base, disc shining, sparsely punctate, more evidently near the base. Elytra distinctly not closely punctate, smoother at apex, sutural region slightly depressed near the base, the suture itself slightly elevated. Body beneath piceous, with slight metallic lustre. Legs piceous, the anterior knees and the front tibiæ in great part yellow. Length .18—.20 inch.; 4.5—5 mm.

*Male.*—Last ventral piceous, shining, the disc transversely flattened, the apex feebly emarginate; posterior tibiæ stout and rather strongly curved.

*Female.*—Last ventral acutely oval at tip; hind tibiæ slightly arcuate.

This species is closely related to *loripes*, but differs in the color of

the thorax and the more distinctly punctured surface. The only variation is that due to the tendency of the blue metallic surface to piceous green or coppery-bronze.

From the fact that the hind tibiæ of the female are curved (but less than in the male) in this species, it is possible that the other two species with curved tibiæ in the male may have similar females. In that case they would form a series by themselves in the genus, as the genus might be divided into *Scelida* for those with straight hind tibiæ, and *Scelolyperus* for the others.

Collected by Mr. E. A. Schwarz at Hood River [illegible] Oregon; another in my cabinet from northern California.

**S. longulus** Lec. (*Luperus*), Pacific R. R. Rep. Ins. p. 69; Proc. Acad. 1865, p. 209; *nigrocyaneus* Lec., Bull. U. S. Geol. Surv. 1879, p. 517.—Form narrow, elongate, piceous, with slight green-bronze lustre. Antennæ more than half the length of the body, piceous, the three basal joints paler beneath. Head smooth, black. Thorax broader than long, slightly narrower in front, sides arcuate anteriorly, then slightly convergent to base, disc convex, usually sparsely punctate. Elytra elongate, nearly parallel, the surface slightly scabrous, distinctly alutaceous and not punctate. Body beneath piceous, shining. Legs piceous, the front tibiæ somewhat paler. Length .18—.20 inch.; 4.5—5 mm.

*Male.*—Last ventral segment truncate at middle with a slight sinuation each side, the disc slightly concave.

*Female.*—Last ventral longer, oval at tip.

This species varies but little. The thorax is usually distinctly sparsely punctate, but specimens occur quite smooth. Typical specimens of *nigrocyaneus* show that they differ merely in smaller size from *longula*.

Occurs in northern California, Oregon, Nevada, Montana, Colorado, Utah and Texas.

**S. decipiens** n. sp.—Form narrow, elongate, nearly as in *longula*, piceous, shining, with a faint bluish lustre. Antennæ more than half the length of the body, piceous, the four basal joints yellow in great part, the outer joints broadened and flattened, the eleventh distinctly longer than the tenth, joints 2–3–4 gradually longer. Head finely transversely wrinkled, the transverse groove entire. Thorax very little wider than long, widest in front of middle, sides feebly arcuate, hind angles sharply rectangular, disc nearly smooth ♂, sparsely punctate at base and sides ♀. Elytra nearly twice as long as wide, alutaceous, very sparsely minutely punctate. Body beneath piceous. Legs piceous, the anterior tibiæ at knee and the first joint of all the tarsi at base yellowish. Length .16—.18 inch.; 4—4.5 mm.

*Male.*—Last ventral segment prolonged at middle in a short truncate lobe; tarsi not dilated; outer joints of antennæ slightly concave on the underside.

*Female.*—Last ventral oval at tip; outer joints of antennæ not concave.

This species resembles *longula* so closely that it would be mixed

with that species without an examination of the antennæ. The sexual characters are not very different, except that in *decipiens* the middle truncate portion of the last ventral is slightly more prolonged.

Occurs at Yreka, Cal., collected by Mr. Wm. Duenkel.

### TRACHYSCELIDA n. g.

This new name is proposed for a species described posthumously by Dr. LeConte as *Agelastica bicolor*. The characters are those of *Luperus*, excepting that the tibiæ are all without spurs. The first joint of the hind tarsus is nearly as long as the three following joints together and slender. The anterior coxæ are very narrowly separated, the cavities open behind.

The length of the first joint of the hind tarsus excludes it from association with *Agelastica*, and by that character, and the absence of tibial spurs, it approaches *Scelida*. From the latter genus it is separated, by its broadly oval and convex form and by the front coxæ being narrowly separated by the prosternum.

**T. bicolor** Lec., Trans. Am. Ent. Soc. xii, November, 1884, p. 28.—Form rather broadly oval, convex, body and legs honey-yellow, elytra black, surface shining. Antennæ piceous, the four basal joints pale. Head smooth. Thorax more than twice as wide as long, slightly narrower in front, sides very slightly arcuate, angles rather obtuse, disc convex, smooth and shining. Elytra oval, broader behind, convex, disc slightly impressed behind the scutellum; surface punctate, regularly over the entire surface, the punctures not coarse nor close. Body beneath smooth, with very sparse pubescence. Length .21 inch.; 5.5 mm.

The only specimen examined is the type described by Dr. LeConte under the genus *Agelastica*, a female, in which the last ventral is oval at tip and entire.

The species resembles very closely the figure given by Jacoby, Biol. Cent.-Amer. vi, pt. i, pl. 34, fig. 4, of *Metacycla robusta*, and is about the same size. The latter species seems not to be a *Metacycla*.

Collected at Fort Yuma, Cal.

### LUPERODES Motsch.

Head not deeply inserted, transversely grooved between the eyes and carinate between the antennæ. Eyes slightly oval, moderately prominent. Antennæ slender, longer than half the body, joints 2–3 often small, together not longer than the fourth; labrum transverse, slightly emarginate; maxillary palpi not stout, the last two joints subequal in length, the last more slender, conical and acute; prothorax variable in form, from transverse to quadrate, the hind an-

gles sometimes dentiform and prominent, the disc never distinctly impressed. Elytra oval, oblong-oval or parallel, the epipleuræ extending nearly to the apex; anterior coxal cavities open behind, sometimes absolutely confluent, often with a narrow prolongation of the prosternum separating the coxæ. Legs slender, not long, the tibiæ slender, slightly broader at tip, all with a terminal spur, that of the posterior pair usually longer; hind tarsi variable; claws appendiculate and divaricate.

To the genus *Luperodes* all those species of *Luperus*, described in our fauna, are referred, excepting those which have already been referred to *Scelida*.

The original description of *Luperodes*, by Motschulsky, gives nothing tangible by which it can be distinguished from *Luperus*, and the method adopted by Mr. Jacoby is equally objectionable. In the absence of any of Motschulsky's species for comparison and study I find myself compelled to rely entirely on the differential characters given by Chapuis, that is to say, in *Luperodes* all the tibiæ have a terminal spur, while in *Luperus* the posterior tibiæ alone are so formed. This character is not at all times easy to observe, but this is no excuse for neglecting it as a valid structural difference.

Since the above paragraph was written I have received, through the kindness of Mr. Jacoby, a specimen of *Luperodes nigripennis* Motsch. In studying this, in comparison with *Luperus niger* Göze sent at the same time, there seems no reason for a change of opinion. Our *L. thoracicus* very closely resembles *nigripennis*, except in its pale legs, and several other species have the same oval form, from which there is a gradual transition in our series to the elongate form, which is thought to be the more characteristic form of *Luperus*.

Two other genera are placed by Chapuis in close proximity to *Luperodes*, and separated from it by the relative lengths of the joints of the posterior tarsi. From the characters given, some of our species should be referred to these genera, *Astena* and *Iphidea*, but our species show such a degree of variation in respect to the relative lengths of the tarsal joints that it has been thought best to retain all in the one genus.

In those species of decidedly oval form, such as *thoracicus*, *luteicollis*, *varicornis* and *atriceps*, the first joint of the hind tarsus is fully as long, or even a little longer than the three following joints together, while in the more oblong forms the rule is that the first joint is a little shorter than the next three, although several excep-

tions will be found. So, also, with the second joint in its relation to the third; in many cases the former is twice the length of the latter; often they are about equal, while others act as intergrades.

The relative length of the second, third and fourth joints of the antennæ is subject to considerable variation. In about half the species the second and third joints are small, the third always a little longer than the second, the two together not as long as the fourth. In two species, *spretus* and *texanus*, the second is very much smaller than the third, which is nearly as long as the fourth. In the remainder of the species the three joints are respectively gradually longer, so that the second and third together are longer than the fourth.

The structure of the prosternum also requires attention. In those species of the more oval form and with the widest thorax, as in *thoracicus* and *varicornis*, the front coxæ are absolutely contiguous without trace of prosternum between them, while the more oblong species have, in most cases, the coxæ separated by a very narrow prolongation of the prosternum. Had the length of the hind tarsal joint and the form of prosternum been concurrent in all cases, there might have been good reasons for dividing the genus, but, as before stated, the first hind tarsal joint varies so much in its relation to the other joints that nothing positive can be done with it.

One of the minor peculiarities of the species of this genus requires particular attention, and that is the coloration of the legs. It seems, indeed, remarkable that such apparently trivial differences of coloration should be indicative of specific distinctness, but the persistency of color, and its almost absolute invariability within specific limits, is proven by the presence of other characters often sexual.

The coloration of the antennæ is less invariable than that of the legs.

The general color shows no variation within specific limits, excepting so far as the metallic-blues vary to green.

The comparatively numerous species are from all parts of the country, each species, with few exceptions, of limited distribution. They may be separated by the following table:*

* *Luperus thoracicus* Boh., Eug. Resa, Ins. p. 181, described as from San Francisco, has not been identified, and, like very many of the species there described, may not be from California at all. The name is preoccupied, and should be dropped from the literature.

Body above yellow or pale castaneous; head yellow, except in *atriceps*; elytra vittate in *bivittatus* ..... 2.

Body above bicolored or metallic; head black ..... 3.

2.—Elytra with the suture and a vitta piceous ..... **bivittatus.**

Elytra not vittate.

Head never black, legs testaceous, or with the tibiæ darker; surface shining ..... **varicornis.**

Head, legs and underside black; surface subopaque ..... **atriceps.**

3.—Thorax yellow ..... 4.

Thorax blue or black ..... 8.

4.—Form oval; thorax twice as wide as long; prosternum not visible between the coxæ ..... 5.

Form oblong; thorax not much wider than long ..... 6.

5.—Elytra piceous, sparsely punctate; legs almost entirely yellow. **thoracicus.**

Elytra dull blue, densely punctulate; legs entirely black ..... **luteicollis.**

6.—Prosternum not visible between the coxæ; second joint of antennæ very small ..... **texanus.**

Prosternum quite distinct between the coxæ; second joint of antennæ a little shorter than the third ..... 7.

7.—Elytra at most obsoletely punctate, usually nearly smooth.

All the tibiæ yellow ..... **transitus.**

Anterior tibiæ alone yellow ..... **laticeps.**

Legs piceous, all the knees slightly paler ..... **Wickhami.**

Elytra very evidently punctate.

Anterior knees alone yellow ..... **torquatus.**

8.—Antennæ entirely yellow; legs yellow, or more yellow than piceous ..... 9.

Antennæ in great part piceous; legs black, or with but little yellow (except in *spretus*) ..... 10.

9.—Legs entirely yellow; elytra minutely alutaceous, without punctuation. **Lecontei.**

Legs more or less varied with piceous.

Elytra punctate and alutaceous; hind angles of thorax dentiform; all three femora more or less piceous ..... **meraca.**

Elytra very obsoletely punctate, scarcely alutaceous; hind angles of thorax not dentiform; middle and posterior femora partly piceous. **cyanellus.**

10.—Legs entirely black ..... 11.

Legs bicolored ..... 12.

11.—Body blue; surface punctate and alutaceous; antennæ bicolored at base. **smaragdinus.**

Body above black, sparsely punctate, not alutaceous; antennæ black. **morulus.**

12.—Legs in great part yellow, the femora piceous at base ..... **spretus.**

Anterior tibiæ and knees, middle and posterior knees also yellow. **Morrisoni.**

Anterior tibiæ and knees yellow ..... **varipes.**

**L. bivittatus** Lec., Proc. Acad. 1859, p. 81; loc. cit. 1865, p. 209.—Form elongate, beneath piceous, above yellow, each elytron with the suture and a vitta

from the umbone piceous, legs yellow. Antennæ yellow, longer than half the body, joint 2 shorter than 3, this shorter than 4, 2 and 3 together longer than 4. Head smooth, the transverse impression arched upward, not reaching the eyes. Thorax one-fourth wider than long, sides arcuate, hind angles not prominent, disc regularly convex, smooth; scutellum black. Elytra about twice as long as wide, sides nearly parallel, surface scarcely visibly punctate, the sutural and discal stripes not reaching the apex. Length .20—.22 inch.; 5—5.5 mm.

*Male.*—First joint of anterior and middle tarsi slightly thickened. Last ventral segment truncate at middle, the disc with a vague triangular depression.

*Femele.*—Tarsi not thickened. Last ventral oval at tip.

The first joint of the posterior tarsi is about a third the length of the tibia and a little longer than the next two joints.

No variation has been observed in the numerous specimens examined.

This species is peculiar in being the only species in our fauna with vittate or ornate elytra.

Occurs in California in the coast range region south of San Francisco, at Tejon and near Yuma.

**L. varicornis** Lec., Trans. Am. Ent. Soc. ii, 1868, p. 57; *brunneus* Crotch, Proc. Acad. 1873, p. 54.—Oval, slightly oblong, entirely pale yellow, varying to pale castaneous, metasternum sometimes piceous. Antennæ two-thirds the length of body, variable in color from entirely piceous to banded with the basal joints pale, joints 2–3 small, nearly equal in length, the two together equal to the fourth. Head smooth, the transverse impression straight, attaining the eyes. Thorax about a third wider than long, slightly narrowed in front, sides feebly arcuate, hind angles slightly prominent, disc smooth. Elytra about a third longer than wide, sides arcuate, surface sparsely punctate, the punctures varying in distinctness in different specimens. Length .12—.17 inch.; 3—4.5 mm.

*Male.*—Last ventral truncate at middle, with a linear incisure each side extending half the length of the segment; tarsi not dilated.

*Female.*—Last ventral oval at tip.

The first joint of the hind tarsus is nearly half the length of the tibia, and much longer than the next two joints together.

This species varies in color, as has been stated, from pale yellow to brownish. The punctuation of the elytra may be nearly obsolete, or fairly distinct. The antennæ are often entirely piceous, or the three basal joints may be pale. Many specimens occur with the outer joints pale at base, while the three basal joints are entirely pale. The legs are usually entirely pale, but specimens occur with the posterior four tibiæ and tarsi infuscate. The metasternum is rarely piceous.

*L. brunneus* Crotch was founded on specimens from the Zimmerman collection (one of them is now before me) discolored, probably, by age.

Specimens are known to me from North Carolina, Georgia, Texas, Kansas and Arizona.

**L. atriceps** n. sp.—Form oval, body beneath, head, legs and antennæ black; thorax, elytra and abdomen dull yellow, subopaque. Antennæ two-thirds the length of body, second and third joints small, nearly equal, together a little longer than the fourth. Head alutaceous, opaque, the transverse impression straight, a short, median, impressed line. Thorax more than a half wider than long, slightly narrowed in front, sides feebly arcuate, hind angles obtuse, disc evenly convex, surface alutaceous, moderately closely punctulate; scutellum piceous. Elytra one-half longer than wide, sides arcuate, surface moderately closely punctulate. Length .18 inch.; 4.5 mm.

The specimen before me is a female with the usual oval last ventral segment.

The first joint of the hind tarsus is more than a third the length of the tibia and slightly longer than the next three joints together.

This species resembles some of the forms of *varicornis*, but differs in its coloration and more punctate surface.

One specimen; Arizona, without more definite indication of locality, from Mr. Aug. Merkel.

**L. thoracicus** Mels., Proc. Acad. iii, p. 162; Lec., Proc. Acad. 1865, p. 209. —Oval, slightly oblong, black; thorax and legs, in great part, yellow. Antennæ two-thirds the length of the body, entirely black, third joint slightly longer than second, these two together a little longer than the fourth. Head smooth, the transverse impression straight, not reaching the eyes. Thorax nearly twice as wide as long, not narrowed in front, sides feebly arcuate, hind angles not prominent, disc moderately convex, sparsely obsoletely punctate. Elytra nearly twice as long as wide, sides feebly arcuate, surface smooth, sparsely obsoletely punctate, but less at sides and apex. Body beneath, except pro- and mesothorax, black. Legs yellow, tarsi fuscous. Length .18—.20 inch.; 4.5—5 mm.

*Male.*—First joint of anterior and middle tarsi distinctly dilated. Last ventral segment truncate at middle, with a linear incisure each side extending half the length of the segment.

*Female.*—Last ventral oval at tip.

The first joint of the hind tarsus is less than half the length of the tibia, and equal to all the following joints together.

The ventral sexual characters of this species are very like those of *varicornis*, but the latter has not dilated tarsi.

This species is widely distributed, but does not seem common. It is known from Pennsylvania, Maryland, Georgia and Kansas.

**L. luteicollis** Lec., Trans, Am. Ent. Soc. ii, 1868, p. 57.—Oval, slightly oblong; body beneath, head and legs, black; thorax yellow, elytra dull blue. Antennæ black, two-thirds the length of body, third joint a little longer than the second, the two equal to the fourth. Head sparsely punctate and alutaceous, the transverse impression straight and entire. Thorax nearly twice as wide as

long, slightly narrowed in front, sides very feebly arcuate, hind angles not prominent, disc convex, a very vague fovea each side, surface closely and rather finely punctate, not shining. Elytra nearly twice as long as wide, sides feebly arcuate, surface finely scabrous and very finely punctulate. Length .16—.18 inch.; 4—4.5 mm.

*Male.*—First joint of the anterior and middle tarsi distinctly thickened. Last ventral truncate, with a rectilinear incisure each side as in *thoracicus*.

*Female.*—Last ventral oval at tip.

The first joint of the hind tarsus is one-third the length of the tibia, and as long as the following joints together.

This species is peculiar in the densely finely punctate and opaque surface.

Occurs in Colorado and New Mexico.

**L. texanus** n. sp.—Form oblong, parallel, black, thorax and legs (except bases of femora) yellow. Antennæ two-thirds the length of the body, brown, the basal five joints pale, joint two small, nodiform, third three-fourths the length of the fourth. Head smooth, transverse impression straight, entire. Thorax one-third wider than long, widest in front of middle, not narrower in front, sides arcuate, hind angles not prominent, disc smooth. Elytra twice as long as wide, sides very feebly arcuate, disc sparsely, but distinctly punctate, nearly smooth at apex, surface shining. Body beneath black, prosternum piceous, not at all prolonged between the coxæ. Legs yellow, the bases of the femora piceous, but less on the anterior pair. Length .16 inch.; 4 mm.

*Female.*—Last ventral acutely oval at tip.

The first joint of the hind tarsus is scarcely more than a fourth of the length of the tibia, and not as long as the following joints together.

This species begins a series of oblong form and with yellow thorax. They seem to be very closely related, but may be separated by a strict regard for the characters given in the table, the present being especially well separated by the absence of any metallic coloring and by the front coxæ being absolutely contiguous.

Occurs in Texas, special locality unknown.

**L. transitus** n. sp.—Elongate, parallel, beneath piceous, head and elytra metallic-green or bluish, thorax yellow. Antennæ two-thirds the length of body, piceous, the basal five joints yellow, with brownish streak above, joints 2–3–4 gradually longer. Head smooth, the transverse impression straight and entire. Thorax a little wider than long, widest in front of middle, sides slightly arcuate in front, oblique posteriorly, hind angles slightly prominent, disc convex, smooth; scutellum piceous. Elytra rather more than twice as wide as long, sides parallel, disc sparsely punctate, sides and apex smooth; prosternum with a linear prolongation between the coxæ; femora piceous, with metallic lustre, the tips with the tibiæ and tarsi yellow. Length .16 inch.; 4 mm.

*Male.*—First joint of front tarsi slightly thickened. Last ventral segment broadly truncate, the disc slightly flattened.

*Female.*—Last ventral oval at tip.

The first joint of the hind tarsus is one-third the length of the tibia, and about as long as the following joints together.

From the localities given by Dr. LeConte I am quite confident that this species was mixed by him with *torquatus*, from which it differs in having all the tibiæ and tarsi yellow, and by the smooth thorax and much less punctate elytra.

Occurs in California, Santa Barbara, San Mateo and Dunsmuir (Wickham).

**L. laticeps** n. sp.—Moderately elongate, parallel, beneath black, head and elytra bluish green, thorax yellow. Antennæ two-thirds the length of body, piceous, the basal three and part of fourth yellow, joints 2–3–4 gradually longer. Head smooth, the transverse impression angulate, deep, entire. Thorax about a half wider than long, widest in front of middle, sides anteriorly arcuate and thence slightly oblique to base, hind angles slightly prominent, disc convex, smooth. Elytra twice as long as wide, the sides nearly parallel, surface alutaceous, very sparsely, finely punctulate; prosternum very narrowly prolonged between the coxæ. Legs piceous, the anterior tibia and apex of femur and the apex of middle femur and base of tibia yellow. Length .15 inch.; 3.75 mm.

*Male.*—First joint of middle and anterior tarsi slightly thickened; the last ventral segment broadly truncate and slightly concave.

*Female.*—Last ventral oval at tip.

The first joint of the hind tarsus is one-third the length of tibia and scarcely as long as the following joints together.

When viewed from above the front is rather flat, and the eyes a little more prominent than usual, giving the head a somewhat broader appearance.

This species is closely related to *torquatus*, but has a differently shaped and smooth thorax. The elytra are also alutaceous and much less punctate, and the legs differently colored.

Two specimens; California, region unknown.

**L. Wickhami** n. sp.—Oblong, nearly parallel, beneath piceous; above, head and elytra bluish green, thorax yellow. Antennæ longer than half the body, piceous; joints 2–3–4 gradually longer. Head smooth, the frontal transverse impression scarcely reaching the eyes. Thorax about one-fourth wider than long, widest in front of middle, base and apex equal, sides arcuate, hind angles not prominent, surface smooth. Elytra not twice as long as wide, very obsoletely sparsely punctate, the surface shining; prosternum narrowly prolonged between the coxæ. Legs piceous with greenish lustre, all the knees faintly paler. Length .14—.16 inch.; 3.5—4 mm.

*Male.*—Last ventral segment with a narrow, slightly prolonged truncation limited each side by a notch, the disc slightly concave; tarsi not dilated.

*Female.*—Last ventral oval at tip.

The first joint of the hind tarsus not quite a third the length of the tibia and not longer than the next two joints together.

This species is, by the color of the legs, more nearly related to *torquatus*, but the latter has the elytral punctuation so well marked, while in the present species and the two which precede, the punctuation is almost obliterated.

Occurs in Arizona at Peach Springs (Wickham).

**L. torquatus** Lec., Trans. Am. Ent. Soc. xii, 1884, p. 28.—Form elongate, nearly parallel, beneath and head black, thorax yellow, elytra metallic-blue or green. Antennæ a little longer than half the body, piceous, the basal five joints testaceous beneath, joints 2–3 nearly equal, the fourth but little longer than the third. Head greenish, smooth, the transverse impression entire. Thorax very little wider than long, slightly narrowed in front, sides feebly arcuate, hind angles not prominent, disc convex, sparsely punctate, shining. Elytra rather more than twice as long as wide, sides nearly parallel, surface indistinctly alutaceous, very evidently punctate, but not closely; prosternum narrowly prolonged between the coxæ. Legs black, the anterior knees and a portion of the tibia testaceous. Length .12—.16 inch.; 3—4 mm.

*Male.*—First joint of front and middle tarsi distinctly thickened. Last ventral truncate at middle, the disc flat and rather smooth.

*Female.*—Last ventral oval at tip.

The first joint of the hind tarsus is about a fourth the length of the tibia and not as long as the following joints united.

Occurs in California, Los Angeles and southward.

**L. Lecontii** Crotch, Proc. Acad. 1873, p. 54; *rufipes* ‖ Lec., Col. Kans. p. 27. —Form moderately elongate. Body beneath, head and thorax black, elytra blue, antennæ and legs entirely yellow. Antennæ more than half the length of the body, joints 2–3–4 gradually longer. Head alutaceous, transverse impression deep and entire. Thorax a little wider than long, sides slightly arcuate in front, hind angles prominent, disc convex, smooth. Elytra nearly twice as long as wide, sides slightly arcuate, surface alutaceous, with very minute punctures sparsely scattered; prosternum very narrowly prolonged between the coxæ. Legs entirely yellow. Length .20 inch.; 5 mm.

*Female.*—Last ventral oval at tip.

The first joint of hind tarsus is nearly half the length of the tibia, and as long as the following joints together.

Closely resembles *meraca*, which, however, has the elytra more shining and more punctate, and all the femora at base are piceous.

Occurs in New Mexico, near Santa Fé.

**L. meraca** Say, Journ. Acad. v, 299; ed. Lec. ii, p. 344.—Form elongate, beneath piceous, above dark blue or blue-black. Antennæ two-thirds as long as the body, entirely yellow, joints 2–3–4, gradually longer. Head slightly alutaceous, sparsely punctate, transverse impression deep and entire. Thorax scarcely wider than long, sides feebly arcuate in front, slightly sinuate behind, angles acute and prominent, disc convex, smooth. Elytra fully twice as long as wide, sides nearly parallel, surface faintly alutaceous, sparsely punctate; prosternum

narrowly prolonged between the coxæ. Legs yellow, the basal half of the femora piceous. Length .20 inch.; 5 mm.

*Male.*—First joint of anterior and middle tarsi slightly thickened. Last ventral broadly truncate, disc smooth.

*Female.*—Last ventral oval at tip.

The first joint of the hind tarsus is nearly a third the length of tibia, but not as long as the following joints together.

This species is easily distinguished by its sculpture and color of legs from *Lecontii* and from *cyanellus* by the more nearly square thorax.

The elytral punctuation varies in distinctness, the males before me are smoother than the females.

Occurs in New Hampshire, Massachusetts, Pennsylvania, Georgia, Illinois, Kansas.

**L. cyanellus** Lec., Proc. Acad. 1865, p. 209.—Oblong-oval, beneath piceous, above blue. Antennæ entirely yellow, a little longer than half the body, joints 2-3-4 gradually longer. Head indistinctly alutaceous, the transverse depression deep, entire, deflexed at middle. Thorax nearly a third wider than long, widest at middle, sides regularly arcuate, hind angles not prominent, disc convex, smooth, sparsely punctate at sides and base. Elytra not twice as long as wide, sides slightly arcuate, disc shining, indistinctly alutaceous, sparsely finely punctate; prosternum very narrowly prolonged between the coxæ. Legs usually entirely yellow, rarely with the middle and posterior femora infuscate near the base. Length .12—.18 inch.; 3—4.5 mm.

*Male.*—Front and middle tarsi not dilated. Last ventral truncate, disc smooth.

*Female.*—Last ventral oval.

The first joint of the hind tarsus is not more than a fourth the length of the tibia and shorter than the following joints together.

This species is more shining than either *meraca* or *Lecontii*, and less distinctly punctate than the former. It has a broader thorax than either, and with less prominent hind angles.

Occurs in Pennsylvania, Missouri, Illinois.

**L. smaragdinus** Lec., Proc. Acad. 1859, p. 286.—Form moderately elongate, beneath and legs black, above blue. Antennæ two-thirds the length of body, piceous, the four basal joints pale beneath, joints 2-3-4 gradually longer. Head indistinctly alutaceous, the transverse impression deep and entire. Thorax one-fourth wider than long, sides slightly arcuate in front, then oblique to base, hind angles not prominent, disc moderately convex, indistinctly alutaceous, sparsely punctate. Elytra fully twice as long as wide, sides parallel, surface indistinctly alutaceous, sparsely finely punctate; prosternum very narrowly prolonged between the coxæ. Length .23 inch.; 6 mm.

*Male.*—Last ventral obtusely truncate, the surface smooth; first joint of anterior and middle tarsi slightly dilated.

First joint of hind tarsus scarcely one-third as long as the tibia and shorter than the following joints together.

This species is the only one in our fauna entirely blue above with black legs. It resembles very greatly *Scelida graptoderoides*, but may be known by the presence of spurs on all the tibiæ.

Occurs in California, Punto de los Reyes.

**L. morulus** Lec., Proc. Acad. 1865, p. 210.—Oblong-oval, black, shining. Antennæ a little longer than half the body, second joint a little longer than half the third, these two longer than the fourth. Head smooth, the transverse impression straight, entire. Thorax one-half wider than long, sides feebly arcuate, hind angles not prominent, disc moderately convex, a vague depression each side, sparsely finely punctate near the front angles. Elytra one-half longer than wide, sparsely and very finely punctate; prosternum very narrowly prolonged between the coxæ. Body beneath black, shining. Length .14 inch.; 3.5 mm.

*Male.*—Last ventral truncate at middle with a linear incisure, each side extending half the length of the segment.

The hind legs are unfortunately wanting in my specimen.

The sexual characters of the last ventral of the male are precisely those of *thoracicus* and *varicornis*. The length given by LeConte, .4 inch., is plainly a misprint.

Occurs in Texas, precise locality unknown.

**L. spretus** n. sp.—Oblong-oval, black, shining, four basal joints of the antennæ and the legs (except femora at base) yellow. Antennæ three-fourths the length of the body, second joint small, nodiform, scarcely half the third, these two as long as the fourth. Head smooth, transverse impression straight, entire. Thorax one-third wider than long, widest in front of middle, sides feebly arcuate, hind angles not prominent, disc convex, smooth, a few very fine punctures near the front angles. Elytra shining, sparsely finely punctate; prosternum narrowly prolonged between the coxæ. Legs entirely yellow, except the bases of the femora. Length .16 inch.; 4 mm.

The male is unknown.

The first joint of the hind tarsus is one-third the length of the tibia, and scarcely as long as the following joints together.

This species greatly resembles *texanus* in form, but differs in being totally black above, and by the elytra much less distinctly punctate. It also resembles the European *Luperus niger*, but differs in having terminal spurs to all the tibiæ and the anterior coxæ distinctly separated by the prosternum.

Occurs in Texas, precise region unknown.

**L. Morrisoni** Jacoby, Biol. Cent.-Amer. vi, pt. 1, p. 595.—Oblong, beneath piceous, above metallic-blue or green. Antennæ two-thirds the length of body, piceous externally, the four or five basal joints pale, joints 2–3 oblong, nearly equal in length, the two longer than the fourth. Head smooth, the transverse impression deflexed at middle, entire. Thorax one-third wider than long, widest in front of middle, sides anteriorly arcuate, thence slightly oblique to base, hind

angles not prominent, disc moderately convex, sparsely finely punctate, but smoother at middle. Elytra twice as long as wide, sides parallel, surface punctate, but smoother at sides and apex; prosternum narrowly prolonged between the coxæ. Legs piceous, the anterior tibiæ, knees and tarsi, the middle and posterior tibiæ at base pale. Length .18—.20 inch.; 4.5—5 mm.

*Male.*—Anterior and middle first tarsal joint slightly thickened, posterior tibia straight. Last ventral broadly truncate at middle, the disc smooth and slightly concave.

*Female.*—Last ventral broadly oval.

First joint of hind tarsus scarcely a third the length of the tibia, and not as long as the following joints together.

This species closely resembles *varipes*, but has a broader thorax, differently colored legs and less pronounced male sexual characters.

Occurs in southern California and Arizona (Morrison).

**L. varipes** Lec., Pacif. R. R. Rep. p. 69.—Form oblong, moderately elongate, beneath piceous, above bright blue. Antennæ longer than half the body, piceous, the four basal joints testaceous, upperside piceous, joints 2–3–4 gradually longer. Head smooth, the transverse impression entire. Thorax very nearly square, sides feebly arcuate, hind angles slightly prominent, disc moderately convex, sparsely punctate along the base. Elytra twice as long as wide, surface distinctly alutaceous, sparsely punctate, more finely and less distinctly at the sides and apex; prosternum very narrowly prolonged between the coxæ. Legs piceous, middle knees testaceous, anterior femora at apex, the tibiæ and tarsi testaceous. Length .18—.20 inch.; 4.5—5 mm.

*Male.*—The first joint of *all* the tarsi thickened, hind tibiæ slightly arcuate. Last ventral truncate at middle, with a slight sinuation each side, disc slightly concave.

*Female.*—Last ventral oval at tip; tarsi not dilated, tibiæ straight.

The first joint of the hind tarsus is one-third the length of the tibia, and not longer than the other three joints together.

This species varies a little in the punctuation of the thorax; usually the disc is quite smooth, sometimes sparsely punctate. The description by LeConte being comparative with the species then known, gives rather an exaggerated idea of the punctuation.

The dilatation of the first joint of all the tarsi in the male, with the arcuate hind tibiæ, is rather a remarkable character.

Occurs in California from San Francisco northward, extending into Montana and Colorado.

### ANDROLYPERUS Crotch.

Head oval, inserted as far as the eyes, which are slightly oval and prominent; labrum transverse, truncate; maxillary palpi not very stout, the fourth joint twice as long as the third, somewhat fusiform in shape. Antennæ longer than half the body, intermediate joints subserrate in the male, first joint moderately stout, clavate, second

small, ovate, third a little shorter than first, fourth longer than the third, joints five to ten nearly equal in length, shorter than the fourth, but longer than the third, eleventh equal to the fourth. Thorax quadrate, slightly wider than long, sides feebly arcuate, disc not impressed. Elytra oblong-oval, broader in the male; epipleuræ wide, extending three-fourths to apex; prosternum distinctly separating the coxæ; anterior coxal cavities open behind. Legs moderate in length; tibiæ scarcely broader to tip, the outer edge rounded, the apex without spur; tarsi moderate, first joint of posterior pair longer than the next two; claws appendiculate.

This genus was named by Crotch from a pair of specimens in my cabinet and characterized in a few words without any attempt to indicate its relationship beyond that it belongs in the vicinity of *Luperus*. Its position is rather difficult to assign, owing to the want of extensive material for comparison. That it is not very near *Luperus* is shown in the shorter first joint of the hind tarsus and the absence of tibial spurs. On the other hand, that tarsal joint is longer than in the groups in which the joint is at most the length of the next two. From a manuscript label still attached to my specimen, it is evident that Crotch was at first disposed to place the species in *Malacosoma*. There seems no course to be pursued but to place it in a separate group.

**A. fulvus** Crotch, Proc. Acad. 1873, p. 55.—Oblong-oval, subdepressed, above fulvous; head, antennæ, legs, meso-metasternum and last ventral segment piceous black, surface glabrous, shining. Head smooth, a transverse impressed line between the eyes, frontal tubercles flat, clypeus carinate. Thorax quadrate, a little wider than long, sides feebly arcuate in front, thence slightly sinuate to base, base regularly arcuate with a marginal line, a little wider than the apex, hind angles rectangular, anterior angles slightly nodiform, disc convex, smooth and not impressed; scutellum piceous. Elytra oblong-oval, slightly wider behind the middle, disc smooth and shining. Body beneath very sparsely pubescent. Length .20 ♂—.24 ♀ inch.; 5—6 mm.

*Male.*—Antennæ a little more subserrate than the female; third and fourth ventral segments each with two slender processes on each side of the middle of the posterior margin of the segment, the disc flat. Last ventral deeply concave, smooth, piceous; side margin of elytra deeply and irregularly plicate one-fourth from apex.

*Female.*—Ventral segments simple; elytra simple.

In the male there is on each elytron a short, indistinct piceous vitta near the apex.

The male ventral characters are certainly very extraordinary. The structure of the last ventral is not unlike that seen in some

*Phyllobrotica*, but the slender, slightly diverging processes of the third and fourth ventrals are very unusual. The plication of the side margin of the male elytron is also a rare character, but some of the species of *Malacorhinus* are similarly provided.

Two specimens from the coast range region of California, south of San Francisco.

**MALACORHINUS** Jacoby.

Head oval, not deeply inserted, front with a transverse impressed line, frontal tubercles flat. Eyes slightly oval, moderately prominent; labrum transverse, entire; maxillary palpi moderately stout, the terminal joint conical, longer than the preceding. Antennæ slender, longer than half the body, first joint rather stout, second half as long, third as long as first, fourth a little longer than third, joints five to ten equal to third, eleventh a little longer. Thorax quadrate, narrower in front; scutellum broadly triangular. Elytra oval, broader in the male; epipleuræ moderately broad, reaching nearly the apex; prosternum narrowly prolonged between the coxæ, the cavities open behind. Legs slender, tibiæ rounded on the outer edge, the anterior pair without terminal spurs; tarsi moderately long, the first joint of the posterior a little longer than the next two joints together; claws appendiculate.

To this genus *Androlyperus maculatus* is referred. The description by Jacoby is far too short, however, to be absolutely certain, but the facies and the male sexual characters leave very little doubt that our species is congeneric with some of those placed by Jacoby as typical of the genus. The joints, about which there may be doubt, are as follows: Jacoby states that the front coxæ are contiguous; our species has a laminiform prosternum separating them; it is also vaguely stated that the tibiæ are mucronate, but it is not stated whether all are so; the thorax is said to be constricted at base, but our species and all those figured show no constriction, but merely that the thorax is narrower at base than at apical third.

The position of the genus in its relation to those already described is somewhat problematical. It seems to be related to *Malacosoma*, but the tarsi more nearly approach those of the Luperite series. In fact, the female of the only known species has been placed in *Malacosoma* by Allard. At present it will probably be best to associate it with *Androlyperus* to form a group based on the structure of the tarsi and the deformed elytra of the male.

One species occurs in our fauna.

**M. maculatus** Lec., Trans. Am. Ent. Soc. xii, November, 1884, p. 28; *cimex* Allard, Ann. Belg. 1889, p. lxviii.—Oblong-oval, differing in the sexes, color pale blood-red (when recent) or reddish yellow, each elytron with two black spots, surface shining ♀, or with subopaque elytra ♂. Head entirely black, smooth. Antennæ black. Thorax broader than long, narrower at apex, sides very obtusely angulate one-third from apex, thence slightly sinuous to base, hind angles acutely rectangular, anterior angles slightly tuberculate, disc convex at sides only, smooth, polished. Elytra oblong and parallel ♀, or rather broadly oval ♂, each with two irregularly oval piceous spots placed a third from apex and from base, surface smooth, impunctate. Body beneath and legs black, abdomen yellow, the last segment piceous ♀, surface sparsely fulvo-pubescent. Length .27—.31 inch.; 7—8 mm.

*Male.*—Elytra rather broadly oval with subopaque surface, about one-half longer than wide, lateral margin one-third from apex incised, wrinkled and foveate, lateral margin rather widely explanate. Last ventral segment truncate, the apex sinuate, disc foveate near the edge.

*Female.*—Elytra oblong, parallel, polished, rather more than twice as wide as long, margin entire and narrowly prominent. Last ventral oval at tip, entire.

In this species the male has a broader and more depressed form than any of the species figured by Jacoby, while the female is not very unlike in form a depressed *Phyllobrotica*. The sexes are thus so unlike that they might readily be supposed to be distinct species.

Occurs in the southern part of California.

### METACYCLA Baly.

Head not large, not deeply inserted, front oblique. Eyes narrowly oval, entire. Antennæ slender, reaching the tips of the elytra, joint one stout and conical, two half as long, joints 3–11 nearly equal, the fourth a little longer; labrum transverse, slightly emarginate; maxillary palpi not stout, the last joint as long as the preceding and a little more slender; prothorax transverse, narrower at base than at apex; scutellum oval, broader than long. Elytra oblong oval, the epipleuræ moderately broad, extending nearly to apex; prosternum not entending between the coxæ, the coxal cavities open behind. Legs moderate, the tibiæ carinate on the outer edge, a terminal spur on all the tibiæ; claws broadly appendiculate.

This genus is remarkable in the great dissimilarity of the sexes. In the male the elytra completely cover the abdomen, and the form is not unlike *Cerotoma*, while in the female the abdomen is greatly inflated, as in *Meloe*, and the elytra scarcely cover more than a third of its length. Unaware of the identity of the genera, Dr. LeConte described this one as *Gastrogyna*, Dr. Baly's *Metacycla* having been described four years previously.

*Metacycla* forms in the system of Dr. Chapuis a group by itself characterized by the open anterior coxal cavities, distinct epipleuræ, first joint of hind tarsus not longer than the two following; claws appendiculate, and thorax distinctly narrowed behind.

**M. insolita** Lec., Proc. Acad. 1861, p. 338; loc. cit. 1865, p. 311.—Form unlike in the sexes, color dull yellow, each elytron with two small, black spots. Antennæ piceous, basal joint pale, extending to apices of elytra. Head smooth. Thorax twice as wide as long, narrower at base, sides feebly arcuate, anterior angles obtusely prominent, hind angles small, subacute, disc convex, with two vague transverse depressions, surface smooth; scutellum piceous. Elytra coarsely and moderately closely punctate; femora dull yellow, tibiæ and tarsi brown. Length .23 ♂—.46 ♀ inch.; 6—11.5 mm.

*Male.*—Body winged, elytra covering the abdomen. Last ventral truncate with a broad and vague emargination.

*Female.*—Body apterous, abdomen inflated and extended, brownish in color. Last ventral broadly oval at tip.

Occurs at Cape San Lucas, Peninsula of California.

### MALACOSOMA Rosenh.

Head moderate, inserted nearly to the margin of the eyes, front transversely grooved between the antennæ; labrum moderately large, not emarginate. Eyes oval, entire; maxillary palpi with the last two joints obconical, nearly equal in length. Thorax quadrangular, wider than long, disc without depressions; scutellum oval at tip. Elytra distinctly margined at the sides, the epipleuræ extending beyond the middle; prosternum distinctly separating the coxæ but narrow, broadened at tip, the coxal cavities open behind; ventral segments not very unlike in length. Legs moderate, tibiæ slightly broader at tip, with very well developed spurs on all three pairs; tarsi rather stout, the first joint of posterior pair not quite as long as the next two together; claws broadly appendiculate.

The species here placed in *Malacosoma* exhibit some differences from the generic description as given by Chapuis, but in deference to the views of Mr. Jacoby, to whom one of the species was known, they are allowed to remain. M. Bedel observes that, in the European species, the "outer border of the eyes is provided with long grey hairs." In *vittipenne* the lower border of the eyes is ciliate, but not in *brevicorne*.

The two species known may be separated in the following manner:

Antennæ piceous, with the three basal joints pale, the joints three to ten more than twice as long as wide. Elytra yellow, with narrow black vittæ. **vittipenne.**

Antennæ entirely piceous, short and stout, the joints three to ten not twice as long as wide. Elytra dull yellow, varying through brownish to black.

**brevicorne.**

These two species are from the southwestern regions of our country.

**M. vittipenne** n. sp.—Oblong, parallel, slightly depressed, pale yellow, elytra with narrow black vittæ, metasternum and abdomen piceous, surface glabrous, shining. Antennæ slender, more than half the length of the body, black; three basal joints yellow. Head smooth, yellow, occiput with a large piceous spot each side. Thorax one-third wider than long, sides arcuate in front, widest one-third from apex, anterior angles slightly nodiform, disc moderately convex, smooth, shining; scutellum black. Elytra very little wider than the thorax, shining, minutely sparsely punctate, color paler yellow than the thorax, with the side margin not reaching apex, suture and three narrow vittæ black, the middle vitta begins within the humeral umbone at base and extends nearly to apex, the other two vittæ are incomplete in front, but meet around the end of the middle vitta near the apex. Legs always entirely pale. Abdomen sparsely hairy. Length .26 inch.: 6.5 mm.

*Male.*—Last ventral segment truncate at middle, each side of which is a moderately deep notch, the disc of the segment concave.

*Female.*—Last ventral segment with a broadly curved margin.

At first glance this insect very much resembles some of our *Disonychæ* from the style of ornamentation.

The front has a distinct transverse groove between the eyes in this species, but much less marked than in *brevicorne*, and in neither has there been observed any tendency to a carination of the tibiæ near the knee. In both these characters the two species seem at variance with those given by Chapuis.

Occurs in southwestern Texas, precise region unknown.

**M. brevicorne** Jacoby, Biol. Cent.-Amer. vi, pt. 1, p. 582 (December, 1887). —Oblong, parallel, less depressed, color fulvous, the elytra varying to brown or black. Antennæ entirely piceous, extending but little beyond the hind angles of the thorax. Head smooth, a deep transverse frontal impression, color variable, sometimes entirely black, rarely entirely yellow, usually with the front yellow and occiput black. Thorax one-fourth wider than long, sometimes slightly narrower at apex than at base, disc convex, smooth; scutellum piceous. Elytra moderately closely punctate with coriaceous wrinkles, color fulvous, varying to black; epipleuræ of the color of the elytra. Body beneath variable in color, rarely entirely black or yellow, usually with the metasternum alone piceous. Legs somewhat variable in color, sometimes entirely black, usually with the knees, tibiæ and tarsi black. Length .20—.24 inch.: 5—6 mm.

*Male.*—Last ventral segment with a median truncate lobe limited each side by a notch, the disc of the segment with an oval, abrupt depression.

*Female.*—Last ventral oval at tip.

The variations of this insect have been in great part indicated in the description. From the material before me it would seem that

the male has the tendency to become black. One male before me is entirely black, except that the thorax is orange-yellow, but I think I have seen in Mr. Ulke's cabinet an entirely black specimen.

Occurs in Utah and Arizona, and in the State of Coahuila, Mex.

### PHYLLECTHRUS Lec.

Form elongate, surface glabrous and nearly smooth. Head free, eyes oval, entire, distant from the margin of the thorax, front more or less grooved transversely above the insertion of the antennæ, labrum short, emarginate; maxillary palpi stout, the terminal joint acute, narrower and shorter than the preceding. Antennæ moderately long, slender in the ♀, thickened toward the tip ♂ in all the species except *gentilis;* 11-jointed in both sexes, but 10-jointed in the male of *gentilis.* Thorax broader than long, slightly narrowed at base, sides distinctly margined, base arcuate; scutellum oval at tip. Elytra with very distinct lateral margin, epipleuræ narrow, but extending more than half to apex; prosternum obliterated between coxæ; metapleuræ moderately wide and slightly concave longitudinally. Legs moderately long, tibiæ slender and without spurs; first joint of hind tarsi longer than the next two; claws broadly appendiculate at base.

The position of this genus as indicated by Chapuis is by no means satisfactory. With *Phyllobrotica*, especially, it seems to have but little affinity. In the latter genus there is absolutely no lateral margin to the elytra, and consequently no epipleuron properly defined. In *Phyllecthrus*, on the contrary, the margin is even more sharply defined than in many *Luperus*, and the epipleuron as fully developed as in that genus. The length of the first joint of the hind tarsus and the entire absence of tibial spurs on all the feet place its relationship with but few of the groups suggested by Chapuis, and apparently the most closely with the Mimastrites. I am, however, inclined to believe that *Chthoneis* may be related to *Phyllecthrus*, although that genus is known to me by description alone. Assuming a relationship with the Mimastrite (as can easily be done by regarding females alone of *Phyllecthrus*) we are then forced to admit a very close relationship with *Cneorane*. One fact is, however, very evident—too many of the genera of Galerucini have been described from uniques without any published references to sexual peculiarities, which are often a guide to relationship when other characters cause doubt by their double indication.

In the uncertainty from want of specimens of many foreign genera, and from the fact that our small fauna hardly requires the separation of genera in groups, I refrain from indicating a new group.

*Phyllecthrus* is peculiar to our fauna, and contains but few species, which may be separated in the following manner:

Antennæ dissimilar in form in the two sexes, thickened toward the tip ♂ or filiform ♀, but 11-jointed in both sexes.
Scutellum yellow; elytra comparatively smooth.
Elytra wider than the thorax; antennæ piceous in both sexes...**dorsalis.**
Elytra not wider than the thorax; antennæ quite pale ♂, and but little darker ♀.....**parallelus.**
Scutellum black; elytra vaguely subsulcate and distinctly punctate.
Elytra a little wider than thorax; antennæ brown ♂, piceous ♀.
**subsulcatus.**
Antennæ filiform in both sexes and piceous, but 10-jointed ♂, 11-jointed ♀.
Elytra distinctly wider than the thorax and quite smooth; scutellum yellow.
**gentilis.**

**P. dorsalis** Oliv., Ent. vi, p. 646, pl. 4, fig. 54; *atriventris* Say (partim), Journ. Acad. iii, p. 461; ed. Lec. ii, p. 224; Lec., Proc. Acad. 1865, p. 207.—Head, thorax and underside of body yellow, elytra and abdomen black, thorax sometimes with a piceous stripe each side. Antennæ black. Head smooth. Thorax broader than long, sides slightly arcuate at front angles, nearly parallel behind, disc convex, with a vague shallow impression each side, surface smooth; scutellum yellow. Elytra black, shining, usually impunctate, sometimes sparsely punctate. Body beneath quite smooth, abdomen sparsely, finely punctate; femora yellow, tipped with black, tibiæ and tarsi black. Length .24 inch.; 6 mm.

*Male.*—Antennæ 11-jointed, gradually thicker to apex, joints 2 and 3 small and equal, together shorter than the fourth, the fourth but little shorter than the first, eighth joint shorter than the seventh or ninth; middle tibiæ deeply notched on the innerside near the apex; first joint of anterior tarsus shorter than the second; second ventral with a conical process from the middle of the posterior edge.

*Female.*—Antennæ slender, 11-jointed, joints 2 and 3 together equal to the fourth, joints 4-11 nearly equal in length; middle tibiæ simple; first joint of front tarsi fully as long as the second.

*Variations.*—Specimens occur with the broad piceous band near the side of the thorax, or with the thorax entirely yellow. The latter are more generally females. Specimens occur with almost the underside of the body piceous, including the legs. The elytra may be absolutely smooth or punctate, my specimens showing the former to be female and the latter male, but sufficient material is not at hand to say if the character is really sexual.

There seems to be very little doubt that Say has confused two species in his *atriventris*. The general description, except as to the color of the antennæ, will fit this species or *nigripennis* Lec., but the

antennæ are 11-jointed in both sexes here, while in *nigripennis* ♂ they are 10-jointed, as stated by Say.

Occurs abundantly near Washington, D. C. (Schwarz), and from thence westward to Missouri and Texas.

**P. parallelus** n. sp.—Form moderately elongate, parallel, slightly depressed. Head yellow, slightly darker than the thorax, sparsely finely punctate. Thorax wider than long, slightly narrowed behind, sides slightly arcuate in front, thence oblique to the hind angles, disc moderately convex, with a vague crescentic transverse depression, surface smooth, color yellow; scutellum yellow. Elytra but little wider than the thorax; black, shining, the lateral margin narrowly yellow, surface alutaceous, sparsely punctulate; epipleuræ yellow. Body beneath and abdomen piceous. Legs yellow, the hind tibiæ and tarsi and upper line of femora piceous. Length .18 inch.; 4.5 mm.

*Male.*—Antennæ entirely yellow, except upperside of first joint, joints two and three small, together not as long as the fourth, joints four to ten gradually shorter, eleventh longer; middle tibiæ deeply emarginate on the innerside near the apex, first joint of front tarsus very short.

*Female.*—Antennæ slender, darker than in the male, formed as in *subsulcatus;* middle tibiæ simple; first joint of front tarsus as long as the second.

This species may be known in the group in which the male antennæ are 11-jointed by its more parallel form and relatively broader thorax. From *subsulcatus* it is distinguished by its smoother elytra and yellow scutellum, and from *dorsalis* by the yellow margin and epipleuræ, and by the pale antennæ.

Occurs in Texas, region unknown.

**P. subsulcatus** n. sp.—Piceous black, shining, head and thorax entirely yellowish. Head smooth; thorax distinctly wider than long, slightly narrower behind, sides anteriorly slightly arcuate, then nearly straight and slightly convergent to base, disc convex, a slight fovea each side, surface smooth; scutellum piceous. Elytra vaguely subsulcate, distinctly punctate and slightly alutaceous smoother near the apex. Body beneath piceous black, shining; femora in great part piceous; tibiæ and tarsi usually pale. Length .12 inch.; 3 mm.

*Male.*—Antennæ ferruginous, gradually thicker to tip, 11-jointed, joints two and three small and similar, together shorter than the fourth, joints eight and nine subequal, these shorter than either the seventh or tenth; middle tibiæ deeply emarginate on the innerside near the tip; first joint of front tarsus distinctly shorter than the second.

*Female.*—Antennæ piceous, slender, 11-jointed; third joint slightly longer than the second, the two together equal to the fourth; middle tibiæ simple, first joint of anterior tarsus as long as the second.

*Variations.*—The abdomen is nearly always piceous, but specimens are before me with yellow abdomen. A specimen ♂ is before me, probably partially immature, in which the scutellum is yellow, and the basal portion of the elytra also, gradually shading into the piceous. The epipleuræ, abdomen and legs are also yellow.

From the sculpture of the elytra this species at first glance has some resemblance to *Diab. atripennis.* It may be readily known from either of the species of the 11-jointed male series by the elytral sculpture and black scutellum.

Occurs in New Mexico, Texas and Arizona; in the latter region near Yuma and Santa Rita Mountains (Wickham).

**P. gentilis** Lec., Proc. Acad. 1865, p. 208; var. *nigripennis* Lec., Trans. Am. Ent. Soc. 1868, p. 58; *atripennis* (partim ?) Say, Journ. Acad. iii, p. 461; ed. Lec., ii, p. 224; var. *texanus* Lec., Trans. Am. Ent. Soc. xii, p. 28.—Variable in color. Antennæ piceous, the three basal joints variegated. Head entirely yellow, smooth. Thorax a little wider than long, sides nearly straight, disc convex, often with a vague transverse depression, surface smooth, color entirely yellow, or with a broad piceous stripe each side, with intermediate forms; scutellum yellow. Elytra shining, microscopically alutaceous, impunctate, color variable, either entirely black, side margin narrowly pale, or with side and suture more widely yellow; epipleuræ always pale. Body beneath piceous, sometimes entirely yellow. Legs pale, often with the hind tibiæ darker. Length .10—.15 inch.; 2.5—4 mm.

*Male*—Antennæ slender, second joint small, half as long as the third, joints three to ten nearly equal; middle tibiæ with a slight emargination on the inner side near the tip; first joint of anterior tarsi not shorter than the second.

*Female.*—Antennæ slender, joints two and three equal, together a little longer than the fourth, joints four to eleven equal; middle tibiæ not emarginate.

Variations:

Var. **gentilis** Lec.—Thorax with a broad black stripe each side occupying one-third of the disc, but with the extreme margin pale. Elytra black, with the suture, side margin and apex yellow; the underside of the body is usually entirely yellow, but the abdomen may be piceous.

Var. **nigripennis** Lec.—Thorax similar to *gentilis*, but the lateral stripes show more of a tendency to disappear, and one specimen before me has merely a black spot each side in front. Elytra black. Body beneath black, the abdomen sometimes yellow.

Var. **texanus** Lec.—Thorax entirely yellow, without trace of black stripes or spots. Elytra black, with a narrow side margin yellow. Body beneath entirely yellow.

It is probable that Say confounded the variety *nigripennis* with his *atriventris*, as the description of the latter coincides more nearly with what we know as *dorsalis*, while his after remark that the antennæ are 10-jointed, shows that he must have had a specimen of one of the varieties of the present species before him. It is not possible to make Say's name available, as he doubtless intended it to apply to *dorsalis* Oliv.

It seems rather remarkable that with what has been written of *Phyllecthrus*, the fact has not been discovered that this species is the only one in which the male antennæ are 10-jointed.

Occurs from eastern Pennsylvania westward to Kansas, Dacota and Montana, and south to Georgia and Texas. Dr. Hamilton takes the *gentilis* variety on *Robinia pseudacacia* as well as by sweeping low herbiage.

In the Biologia Cent.-Amer. vol. vi, pt. 1, p. 600, Mr. Jacoby describes a genus *Oroetes*, in which the species has the middle tibiæ of the male notched as in *Phyllecthrus*. While it is doubtless distinct, the genus seems related to *Phyllecthrus*.

### GALERUCA Geoff.

Head moderately large, not deeply inserted, front grooved between the antennæ, the tubercles not large. Eyes oval, feebly prominent; labrum short, transverse; maxillary palpi stout, the terminal joint elongate conical, as long as the preceding, but narrower. Antennæ rather stout, not longer than half the body, joint three nearly twice as long as the second, 3–10 gradually decreasing in length, eleventh longer. Thorax transverse; scutellum nearly semicircular. Elytra oval; epipleuræ entire; anterior coxæ contiguous, the cavities closed behind; middle coxæ very narrowly separated. Legs rather robust; tibiæ carinate on the outer edge, slightly broader at apex, the middle pair with one terminal spur; tarsi stout, the first joint of the posterior pair nearly as long as the next two; claws cleft slightly behind the middle.

The name *Galeruca* is adopted for this genus in accordance with the views of Mr. Crotch. It corresponds with *Adimonia*, as recognized by Chapuis and others. In our species the middle tibiæ in both sexes have a well-marked spur, although Chapuis states that the tibiæ are unarmed.

In his remarks on this genus Crotch admitted all the species of LeConte's first group (Proc. Acad. 1865, p. 214), but a closer examination shows that all have the anterior coxal cavities open, except *externa*, which will alone represent the genus in our fauna.

**G. externa** Say, Journ. Acad. iii, p. 458; edit. Lec., ii, p. 222; *rudis* Lec., Pacif. R. R. Rep. p. 69.—Form rather broadly oval, moderately robust, piceous-black, feebly shining, the side margin and apex of elytra yellowish testaceous. Head cribrate-punctate. Thorax more than twice as wide as long, slightly narrowed in front, sides arcuate, parallel behind the middle, hind angles distinct, but obtuse; base oblique each side, disc convex, a vague median depression, surface very coarsely and closely punctate. Elytra on each side quadricostate, often the third entirely absent and the first abbreviated, intervals coarsely and closely punctate, the surface between the punctures alutaceous. Body beneath

shining, very sparsely pubescent; met-episterna densely granulate punctate. Abdomen sparsely punctate, transversely wrinkled at the sides. Length .27—.44 inch.; 7—11 mm.

*Male.*—Last ventral segment broadly, but not deeply emarginate, a depression or fovea at middle of emargination.

*Female.*—Last ventral truncate.

Very little variation has been observed, and consists in the varying degree of coarseness of the punctuation and the greater or less development of the elytral costæ.

Occurs in Kansas, Utah, Nevada, Oregon, Washington and Idaho.

### **CEROTOMA** Chev.

Head free, the muzzle somewhat prolonged. Antennæ slender, first joint rather long, second short, third nearly as long as the first, fourth shorter, joints 5–11 nearly equal; maxillary palpi rather stout, the last joint elongate-conical, shorter than the preceding; anterior coxæ contiguous, their cavities closed behind; epipleuræ moderately wide, extending three-fourths to apex; tibiæ slender, each provided with a terminal spur; first joint of hind tarsus as long as the following joints together; claws broadly appendiculate at base.

One species occurs in our fauna:

**C. trifurcata** Forst., Nov. Spec. Ins. 1771, p. 29; *camineą* Fab., Syst. El. i, p. 459; Oliv., Ent. vi, p. 656, pl. v, fig. 73; Lec., Proc. Acad. 1865, p. 205; var. *furcata* Oliv., loc. cit. 643, pl. iii, fig. 50.—Oval, narrower in front, moderately convex, body beneath and head black, above yellow. Elytra with black, forming a narrow basal band extending in a triangle about the scutellum and prolonged along the sides nearly to apex, sometimes broken, three black spots on each side of and close to the suture, the posterior smaller. Antennæ pale, darker externally. Head black, clypeus very coarsely punctured. Thorax nearly twice as wide as long, slightly narrowed in front, sides feebly arcuate, margin broader posteriorly, disc moderately convex, finely alutaceous, very obsoletely, finely and sparsely punctate; scutellum black. Elytra irregularly subseriately punctate, the punctures not large nor closely placed. Body beneath black, meso- and metapleuræ punctate; abdomen nearly smooth. Legs yellowish testaceous, the front and middle tibiæ in part, the posterior tibiæ entirely black, the femora of the latter black at apex. Length .14—.20 inch.; 3.5—5 mm.

In the male the antennæ do not differ notably from the female, although they are shorter and stouter. The entire front of the male is yellow, only the portion behind the eyes is piceous; the last ventral segment is truncate.

In the female the last ventral is oval and granulately punctate.

The usual coloration of the elytra consists of a triangular scutellar spot, which often sends a narrow stripe along the base to the humeri.

From the umbone a moderately wide stripe extends nearly to apex; this stripe is often interrupted. Near the suture are four subquadrate spots arranged in a quadrangle; near the apex are two smaller spots.

The variation from this observed are as follows: The larger spots forming the quadrangle may be divided longitudinally, producing two linear spots in the place of one. On the other hand, these spots may be longitudinally confluent, so that the two on each elytron form a short vitta. Specimens may occur with pale elytra with merely a small scutellar triangle and a small humeral black spot.

This insect is widely distributed. Specimens are known to me from Canada, Kansas, Texas, North Carolina and New York. None have been reported from the New England States.

**ANDRECTOR** Horn.

Head free, front vertical, a deep transverse depression just beneath the eyes. Antennæ more than half the length of the body, first joint long, second very short, third longer than the first, dilated and emarginate at apex, fourth triangular, with an emargination, the free angle acute, joints 5–11 nearly equal in length; maxillary palpi stout, the last joint conical, shorter than the preceding and slightly narrower at its base; anterior coxæ contiguous, their cavities closed behind; epipleuræ extending three-fourths to apex. Legs as in *Cerotoma*, the posterior and middle tibiæ with spurs; posterior tarsi with first joint as long as the three following united; claws broadly appendiculate at base.

Above the deep transverse depression of the front and below the insertion of the antennæ, is a short laminiform prolongation, obtusely tridentate, the lower edge of the depression has, at middle, an obtusely conical elevation.

By the characters above given it will be seen that the genus is a member of the group Cerotomites, as defined by Chapuis. As in *Cerotoma* the third joint is longer than the fourth. It differs from that genus in the presence of tibial spurs on the middle and hind tibiæ, and by the deep, transverse depression of the front.

In the "Catalogus" Baron Harold has placed this genus in synonymy with *Cerotoma*, but in view of the characters considered valid for generic separation this course cannot be followed.

One species is known to me.

**A. sexpunctatus** Horn, Trans. Am. Ent. Soc. iv, p. 152.—Oblong-oval, narrower in front, pale yellow above and beneath, each elytron with three small

piceous spots arranged in a line from the umbone to the apex. Antennæ pale yellow. Head smooth. Thorax nearly twice as wide as long, slightly narrowed in front, the lateral margin wider posteriorly, surface smooth. Elytra moderately closely, but feebly punctate. Body beneath smooth, shining, the posterior coxæ and the front of met-episterna piceous. Length .22 inch.; 5.5 mm.

This insect is not unlike *Diabrotica* 12-*punctata* in form, but somewhat smaller.

Occurs in Texas, locality unknown (A. S. Fuller).

**AGELASA** Motsch.

Head oval rather broad, inserted as far as the posterior border of the eyes, which are slightly oval, prominent and entire. Antennæ slender, longer than half the body, joints two and three subequal, together a little longer than the fourth, fourth longer than fifth, joints five to ten equal, eleventh longer; maxillary palpi moderately stout, the last joint shorter and more slender than the third; labrum transverse, emarginate. Thorax transversely quadrangular, slightly narrower at base, sides feebly arcuate, hind angles distinct, disc impressed. Elytra oval, broader behind; epipleuræ nearly reaching the tip; anterior coxal cavities closed behind, the prosternum narrowly visible between the coxæ. Legs moderate; tibiæ slightly broader toward tip, the outer edge rounded, not carinate, the middle and posterior tibiæ with a single spur; tarsi moderate, the first joint as long as the next two; claws broadly appendiculate.

**A. halensis** Linn., Syst. Nat. ed. xii, 1767, p. 589; Fairm., Gen. Col. Eur. iv, pl. 69, fig. 330; Lec. (*Agelastica*), Proc. Acad. 1865, p. 210; Chapuis (*Sermyla*), Gen. Col. xi, p. 225.—Form oval, moderately convex, pale yellowish, the elytra metallic-blue or greenish, resembling *Oedionychis gibbitarsis* in form and color. Antennæ piceous. Head yellow, smooth, an occipital band of metallic-blue or green. Thorax rather more than twice as wide as long, sides feebly arcuate in front, disc moderately convex, not visibly punctate, but with a depression each side midway between the median line and side margin. Elytra oval, broadest a little behind the middle, the surface moderately coarsely not closely punctate, punctures irregularly placed and somewhat finer toward the apex. Body beneath honey-yellow, sparsely pubescent, tips of tibiæ and tarsi infuscate. Length .20—.28 inch.; 5—7 mm.

The specimens studied are unfortunately all females which present no special sexual characters.

The specimens on which Dr. LeConte indicated the occurrence of this insect in our fauna were given him by Mr. Edw. Norton as having been collected at Farmington, Conn. For various reasons not necessary to record at this time, the validity of that locality seemed doubtful to me, and of sufficient moment to have caused me

to omit the species from our list, but recently Mr. Ulke has received a specimen from Wisconsin. The species is doubtless an introduced one, and not a member of the sub-arctic fauna common to both continents.

## Doubtful Species.

**Galeruca fibulata** [Germar]; testacea, antennis apice pectoreque fuscis, elytris linea rectangula baseos maculaque ante apicem nigris. Habitat in America septentrionali.

Affinis *G. quadrimaculatæ*, caput flavo-testaceum, oculis antennarumque apice nigris. Thorax subquadratus, marginatus, punctulatus flavo-testaceus. Coleoptera thorace latiora, apice obtuse rotundata, oblongo-quadrata, punctata testacea; linea utrinque basali in humero ramum rectangulum emittente; macula magna ante apicem nigris. Corpus subtus testaceum, pectore fusco.

This description seems to apply very well to some of the varieties of the male of *Cerotoma trifurcata*, and the name would have been placed in synonymy with that did not certain remarks of Dr. LeConte (Proc. Acad. 1865, p. 209) require explanation.

There exists in the LeConte cabinet a specimen which is undoubtedly *Galeruca quadrimaculata* Oliv., and which came originally from the Melsheimer cabinet, and to this Dr. LeConte has attached the name *fibulatus*, and applied the remarks above cited. The specimen has remained unique for at least fifty years. That Olivier might have been in error in his locality is suggested by Dr. LeConte, but it is also possible that Melsheimer may have been in error as other Javanese insects were in his cabinet (see *Pachyurgus æreus* Mels. = *Encyalesthes brevicornis* Motsch. from Java, etc.). *Galeruca quadrinotata* Oliv. seems to have been omitted in the "Catalogus."

**G. dorsata** [Say].—Pale yellowsh, elytra blue, with a yellow outer margin and tip. Inhabits Arkansa.

Body pale yellowish; head black on the vertex; antennæ black brown; thorax immaculate; punctures obsolete; scutel blackish bronze; elytra irregularly punctured, greenish blue; exterior margin and tip yellow; an indented, abbreviated line on the basal middle; feet with blackish line above. Length one-fourth of an inch.

Found on the banks of the Arkansa above the Verdigris. This insect, if it be a Chrysomelidæ at all, has not been identified.

**G. janthina** Lec., Ann. Lyc. 1, p. 173, is *Haltica chalybea* Illig.

## Supplementary Notes.

The following notes have been prepared as a supplement to preceding papers on the Chrysomelidæ with the view of correcting errors, supplying omissions, or describing new forms:

### SYNETA Esch.

In my essay on this genus (Trans. Am. Ent. Soc. xix, p. 3) an error has occurred owing to the improper recognition of the actual type of *simplex* in the LeConte cabinet.

The species cited above as *simplex* should be called *hamata*, from the structure of the male hind tibiæ.

**S. simplex** Lec.—Entire body yellowish testaceous, sometimes with the head and thorax slightly brown. Head coarsely punctate. Thorax strongly angulate at the sides not denticulate, coarsely punctate. Elytra with confused coarse punctuation without serial arrangement and without trace of costæ.

*Male.*—Last ventral segment deeply sinuate each side, the middle projecting as a rounded lobe; hind tibiæ gradually broader to apex as in *albida*, and with terminal spur.

*Female.*—Last ventral with a semicircular pubescent concavity at apex; hind tibiæ less thickened than in the male and with a spur.

In this species the antennæ are formed as in *albida*, that is the joints 8–11 are shorter than the joints 4–7. It may be separated from *albida* by the more strongly angulate thorax, the entire absence of costæ and the confused punctuation.

The type specimen came from Steilacoom, in Oregon; others have been given me by Mr. E. A. Schwarz from Astoria and Tenino. To him I am indebted for having my attention called to the mistake above mentioned.

### OOMORPHUS Curtis.

**O. floridanus** n. sp.—Oval, convex, piceous black, shining, recalling *Orphilus* in form. Head very finely alutaceous, indistinctly sparsely punctate, a short linear frontal impression. Thorax more than twice as wide as long, the sides nearly straight and rapidly divergent from apex to base, disc convex, sparsely indistinctly punctate. Elytra with rows of moderately coarse punctures not closely placed, the intervals with a single series of irregularly placed, smaller punctures. Body beneath piceous black, abdomen finely transversely alutaceous. Length nearly .10 inch.; 2.5 mm.

No sexual peculiarities have been observed.

The genus *Oomorphus* is one of those genera which have been assigned various relationships by those who have studied them. For an interesting recital of those of *Oomorphus* the student may consult the "Genera" x, p. 219.

At present the position usually accepted is in relationship with *Lamprosoma*. The Lamprosomini form a tribe of the Cyclique division of the Chrysomelidæ, taking position between the Cryptocephalini and Eumolpini. From all the other tribes of Cycliques the Lamprosomini are distinguished by the presence of grooves at

the sides of the prosternum for the lodgement of the antennæ in repose. *Oomorphus* has the eighth joint of the antennæ much smaller than either the seventh or ninth, after the manner of some of the genera of Silphidæ.

Our species is about the size of the European, and seems to differ, as far as the descriptions and figures permit comparison, by the sides of the thorax being straight and divergent, the intervals between the series of elytral punctures not being moderately densely punctured, but by the presence of a single series of irregularly placed punctures.

For this very interesting addition to our fauna we are indebted to E. A. Schwarz, who collected them in some numbers at Biscayne, Fla.

**LUPERALTICA** Crotch.

Head oval, inserted nearly as far as the eyes, which are rather prominent and slightly oval, front carinate between the antennæ, with flattened tubercles and a transverse sinuous line between the eyes; labrum rather prominent, entire at tip; maxillary palpi not stout, the terminal joint half the length of the preceding, acutely conical. Antennæ slender, longer than half the body, first joint stout, second small, oval, third twice as long, joints three to ten equal, eleventh longer. Thorax quadrangular, the angles distinct, and with a small piliferous tubercle, disc convex, with a vague transverse impression in front of the base; scutellum triangular. Elytra oblong-oval; epipleuræ moderate in extent, reaching nearly the sutural angle; prosternum either narrowly separating the coxæ, not visible between them, but forming a tubercle at apex, in the latter case the coxæ absolutely contiguous, coxal cavities open behind. Legs moderate in length, the femora all thickened; tibiæ slender, not carinate externally and without terminal spur; tarsi moderate in length, the first joint of the posterior pair as long as the next three; claws appendiculate and divergent; body glabrous.

It is generally admitted that the line of demarcation between the Galerucini and Halticini is not very well marked. The form of the posterior femora of the latter group, constructed for the purpose or with the result of giving a saltatory power to the insect, has been relied upon as the main point of distinction between the two series. As a rule the Halticini have the anterior coxæ well separated by the prosternum, the reverse being the case in the Galerucini, but exceptions occur to the normal character in both groups. It is also rare

to find the tibiæ, especially the posterior pair, without terminal spurs, the mechanical reasons for which in saltatory insects being very evident. One group admitted by Chapuis, the Elithiites, has no spurs, and from the tenor of his remarks it is evident that he has had considerable difficulty in becoming satisfied as to the systematic position the genera of that group should occupy.

The genus *Luperaltica* is equally perplexing. It is composed of two species, in one of which there can hardly be any doubt as to its position, the posterior thighs being well thickened and much stouter than the two anterior pairs, and the anterior coxæ are distinctly separated by the prosternum as required by the normal condition of the Halticini. On the other hand the second species has all the femora slightly thickened, the posterior pair not much more so than the others, but the anterior coxæ are absolutely in contact, the prosternum not prolonged between them. The thickening of the femora in this species (*fuscula*) is scarcely greater than has been observed in many genuine Galerucini.

Both species are deprived of a terminal spur to the posterior tibiæ, a character of rare occurrence in the Halticini, but quite common in the Galerucini.

In further evidence of the difficulty of placing the genus it will be remembered that Dr. LeConte placed the species in *Malacosoma*.

At the time of my study of the Halticini (Trans. Am. Ent. Soc. xvi, p. 271) it was suggested that *Luperaltica* should be dropped from our literature from the very faulty nature of the description, but to avoid confusion the name has been retained and the description amended. *L. senilis* was erroneously referred by me to *Systena*, which it greatly resembles, but the front coxal cavities are open.

Two species are known.

Anterior coxæ contiguous; elytra very indistinctly punctate, color above varying from yellow testaceous to dull blue..... **fuscula.**

Anterior coxæ separated; elytra very evidently punctate, elytra bright metallic-blue..... **senilis.**

*Luperaltica* cannot well be placed in any of the groups suggested by Chapuis. It will take a place in his table near the Elithiites by the absence of posterior tibiæ spurs, differing from that in the form of the claws. In a natural arrangement the group might be well placed after the Crepidoderites.

**L. fuscula** Lec., Proc. Acad. 1865, p. 206; Crotch. ibid. 1873, p. 70.—Form oblong, resembling *Systena*, moderately convex, surface rather dull, color yellow-

ish testaceous, shading to brownish, with blue surface lustre. Antennæ pale palpi piceous. Head piceous, the front and labrum pale. Thorax broader than long, not narrowed in front, sides feebly arcuate, angles all distinct, disc moderately convex, with a vague ante-basal impression and sometimes a faint median line, surface indistinctly punctate and alutaceous. Elytra oblong-oval, widest at middle, surface minutely alutaceous, sparsely indistinctly punctate, a marginal series of punctures larger. Body beneath colored as above, sparsely pubescent. Length .10—.15 inch.; 2.5—4 mm.

*Male.*—First joint of anterior and middle tarsi distinctly dilated. Last ventral segment flattened, truncate at apex with a broad process from the middle of the apical edge and at right angles with it, this process is either obtuse or incised at apex; first ventral between the coxæ convex.

*Female.*—Tarsi not dilated; first ventral not convex. Last ventral truncate, leaving a small retractile segment exposed.

The variation in color has been indicated above, some specimens being a dull indigo-blue, which gradually disappears, the sides and suture retaining the color the longest. The specimens more or less testaceous are the most abundant.

*Longitarsis nigripalpis* Lec., founded on a rather poor specimen, is doubtless synonymous with this species.

Occurs from Pennsylvania and Virginia to Iowa and Kansas.

**L. senilis** Say, Journ. Acad. iv, p. 87; ed. Lec. ii, p. 228; Crotch, Proc. Acad. 1873, p. 70; Horn, Trans. Am. Ent. Soc. 1889, p. 271; *tincta* Lec., Proc. Acad. 1865, p. 206.

As the species is described sufficiently as the last named citation it will not be reproduced here.

The male has a similar last ventral to that of *fuscula*, but the process is shorter and acute.

Occurs from Pennsylvania to Illinois.

## MISCELLANEOUS COLEOPTEROUS STUDIES.

BY GEO. H. HORN, M.D.

The few pages which follow contain descriptions of some new Coleoptera, which, from their exceptional nature, seem worthy of separate treatment, although all of them are rare and from remote regions.

The discovery of a new genus allied to *Schizopus* and *Dystaxia* is very interesting, as these genera form a group of Buprestidæ peculiar to the extreme southwestern regions of our fauna.

The *Dacoderus*, from Texas, has also a special interest in bringing the genus further east and rendering the locality of *D. dominicensis* less improbable, doubt having been expressed by one of my valued correspondents in France of the correctness of the locality.

**GLYPTOSCELIMORPHA** n. g.

This name is proposed for a genus of Buprestidæ allied to *Schizopus* and *Dystaxia*, with the following characters:

Form cylindrical, slightly depressed, slightly narrowed in front, obtuse posteriorly. Head deeply inserted, front nearly vertical, clypeus slightly prolonged, broadly emarginate; labrum transverse, with rounded angles, slightly emarginate in front. Eyes moderately prominent, broadly oval, entire. Antennæ slender, scarcely at all serrate, nearly half as long as the body, first joint stout, second oval, small, third longer than first, fourth a little shorter than third, fifth equal to third, joints five to ten gradually shorter, eleventh half as long as tenth; maxillary palpi moderate in length, slightly thickened to tip, last two joints equal in length, subcylindrical. Thorax broader than long; scutellum oval, broader than long. Elytra nearly parallel, obtuse at tip; prosternum slightly narrowed between the coxæ, tip obtuse, received in an emargination of the ventral mesosternum; metasternal episternum broad, nearly twice as wide as long, slightly broader in front, epimeron small; first two vertical segments closely united with scarcely a trace of suture, these two at the sides as long as the three following segments, the third to fifth gradually decreasing in length. Legs not long, femora rather stout, tibiæ slender, with two terminal spurs; tarsi moderate in length, shorter than the tibiæ, the first three joints with a short lobe, the fourth with a long, deeply divided lobe; first joint of hind tarsus about as long as the next two; claws divaricate, broadened at base, but not toothed.

The relationship of this genus with the other two forming the tribe Schizopini, may be expressed in the following manner:

Antennæ slender, nearly filiform, scarcely at all serrate.
  Claws entire at tip, slightly thickened at base; last joint of antennæ nearly one-half shorter than the tenth ..... **Glyptoscelimorpha.**
  Claws cleft at tip; last joint of antennæ very little shorter than the tenth. **Dystaxia.**
Antennæ flattened, the joints 4—10 broader than long and distinctly serrate.
  Claws cleft at tip; last joint of antennæ oval, longer than the tenth. **Schizopus.**

These genera all occur in southern California.

**G. marmorata** n. sp.—Sub-depressed, cylindrical, brassy-bronze, shining, surface irregularly marmorate with patches of short, recumbent, cinereous pubescence. Antennæ brownish testaceous, the terminal joint black; labrum yellow. Head moderately coarsely closely punctate. Thorax a little less than twice as wide at base as long, slightly narrower in front, sides nearly straight,

angles distinct, not prominent, disc regularly convex, moderately coarsely closely punctate. Elytra a little wider at base than the thorax, humeri obtuse, sides nearly parallel, gradually narrowed at apical third, conjoined apices obtuse, surface closely punctate, but less coarsely than the thorax. Body beneath darker æneous, densely and moderately coarsely punctate and densely clothed with cinereous-white recumbent pubescence. Legs yellowish testaceous. Length .30 inch.; 7.5 mm.

The male has the fifth ventral broadly emarginate, the sixth deeply triangularly incised. The hind tibiæ are slightly arcuate.

At first sight this insect would, in all probability, be mistaken for a *Glyptoscelis;* such was the impression made upon myself.

Occurs near Los Angeles, Cal. Taken by Mr. D. W. Coquillett.

### AGALISSUS Dalm.

**A. chamæropis** n. sp.—Black, shining, elytra dull red with the suture piceous, thorax with four longitudinal lines of white pubescence. Head coarsely sparsely punctured at middle, eyes completely encircled with white recumbent pubescence, which extends along the sides of the front and crosses the edge of the clypeus. Thorax as wide as long, slightly narrowed in front, sides feebly arcuate, disc coarsely sparsely punctate, with four shallow longitudinal grooves extending from apex to base, the two inner grooves interrupted near the base, the grooves densely pitted with white recumbent pubescence; scutellum semi circular, black, glabrous. Elytra wider at base than the thorax, gradually arcuately narrowed to apex, apices rotundate-truncate, the sutural spine short, more distinct in the male, disc vaguely grooved each side of suture, surface moderately coarsely, not closely punctate, each puncture with a short, semi-erect cinereous hair, color dull red, the suture gradually more widely piceous from the base, then more rapidly narrowing at the apical third. Body beneath black, shining, sparsely punctate; propleuræ, sides of metasternum, outer edge of met-episterna and a triangular spot at the sides of each ventral segment with white pubescence. Legs black, sparsely pubescent. Length .76—.85 inch.; 19—21.5 mm.

In the male the antennæ reach the middle of the body, in the female shorter, otherwise, excepting the slightly more slender form of the male, there is no marked sexual difference.

In this species the sides of the elytra behind the humeri are as deeply emarginate as in *gratus*. The differences between the genera *Agalissus* and *Zagymnus* seem to be measurably reduced by the discovery of this species. The front is less oblique than in the former as typified by *gratus*, and not quite vertical as in *Zagymnus*. The apices of the elytra more nearly approach in form the latter genus. The only remaining character seems to be that in *Agalissus* the form of body is narrowed behind, while in *Zagymnus* it is nearly parallel.

Collected at Biscayne, Fla., by Mr. E. A. Schwarz on *Chamærops palmetto*.

## DACODERUS Lec.

This genus now contains three species which may be distinguished in the following manner:

Eyes situated at the hind angles of the head; head and thorax longitudinally striate.
Disc of elytra flat, with the suture slightly elevated, relatively coarsely and closely punctate..... **striaticeps.**
Eyes in front of the hind angles of the head; elytra not flattened on the disc.
Head and thorax longitudinally striate; elytra not distinctly punctate. **lævipennis.**
Head not striate, occiput coarsely sparsely punctate, thorax in front with few punctures ..... **dominicensis.**

**D. lævipennis** n. sp.—Elongate, chestnut-brown, shining. Head quadrate, distinctly prolonged behind the eyes and abruptly narrowing, front deeply concave, the excavation deeply prolonged on the epistoma, occiput rather deeply striate. Thorax one-third longer than wide, much narrowed at apex, sides anteriorly strongly arcuate, thence parallel to base interrupted at middle by an oval, smooth tubercle, disc deeply excavated at middle, the excavation prolonged less deeply to the base, surface deeply striate at middle in front, punctate at sides, posteriorly sparsely punctate. Elytra elongate oval, nearly three times as long as wide, disc not flattened, a few obsolete punctures at base, a few sparsely placed short hairs, subsutural stria fine. Body beneath nearly smooth, the abdomen sparsely obsoletely punctate, a group of coarse, closely placed punctures in front of the anterior coxæ. Legs sparsely punctate. Length .18 inch.; 4.5 mm.

The essential differences between this and the two previously described species are given in the table. Others, however, exist which have some importance. In *striaticeps* the thoracic depression is not prolonged to the base, in *dominicensis* it is prolonged as a triangular depression; in the present species as a deep groove with parallel sides entirely to the base. The entire prosternum and flanks are coarsely closely punctate in *striaticeps*, the middle of the prosternum alone in *dominicensis*, while there is but a small group of punctures in the present species. It is possible in the two older species to pass a hair from the excavation at the middle of the thorax under the oval tubercle and out at the side, but in the present species there is a complete, or nearly so, closure of that passage,

In examining *dominicensis* at the present time a small brush of hair was observed at the middle of the front femur on the underside; a specimen of *striaticeps* has the same character. This is probably sexual, as the specimens are of the slenderest of the forms.

The present species was given me by Mr. A. Bolter, and was collected in Texas.

**MICROSCHATIA** Sol.

From the time certain specimens collected in the Peninsula of California were referred to *M. punctata* Sol. there has been doubt as to the correctness of the identification, although the figure given by Solier represents our specimens more nearly than *punctata;* both species have a depression at the middle of the base of the thorax not shown in the figure. Having, through the kindness of Mr. Champion, examined a true *punctata*, the following notes have been prepared to show the relationship of the species:

Thorax narrower at base than at middle, the hind angles not overlapping the humeri.
  Propleuræ quite smooth; met-episterna distinctly longer than wide.
    Prosternum broad, the apex broad and truncate; epipleuræ not well defined. **punctata.**
    Prosternum rather narrow, the apex acutely oval; epipleuræ well defined. **Championi.**
  Propleuræ sparsely coarsely punctate; met-episterna nearly one-half longer than wide.
    Prosternum broad, very obtuse at apex; epipleuræ well defined.....**polita.**
  Propleuræ coarsely granulate; met-episterna nearly as wide as long.
    Prosternum moderately wide, apex oval, and sometimes subacute; epipleuræ well defined .....**inæqualis.**
Thorax widest at base, or very little narrower than at middle, the hind angles slightly prolonged over the humeri.
  Propleuræ sparsely granulate; met-episterna very little longer than wide.
    Prosternum moderately broad, the apex obtusely oval or subtruncate; epipleuræ well defined.....**morata.**
  Propleuræ punctate; met-episterna slightly longer than wide.
    Prosternum moderately broad, apex truncate; epipleuræ well defined. **sulcipennis.**
    Propleuræ smooth; met episterna a little longer than wide.
    Prosternum broad and truncate, the apex slightly impressed at middle; epipleuræ not well defined.....**robusta.**

**M. punctata** Sol., Ann. Fr. v, p. 475, pl. 11, fig. 22.—In this species the sides of the thorax are regularly arcuate without sinuation, the hind angles distinct, but not prominent; the disc is coarsely sparsely and irregularly punctate, and with a depression at middle of the base. The elytral sculpture consists of coarse punctures arranged in irregular rows, the intervals elevated forming a reticulation, in some varieties there is a tendency in the disc to become subcostate, in which case the general sculpture somewhat approaches that of *Asida sordida*. The prosternum is coarsely cribrately punctured at the sides, broad between the coxæ, the apex broadly truncate. The met-episterna are scarcely longer than wide; epipleuræ not distinctly limited. Length .60 inch.; 15 mm.

The specimens examined are from Zimapan, State of Hidalgo, Mexico.

**M. Championi** n. sp.; *punctata* ‡ Horn., Rev. Teneb. Trans. Am. Philos. Soc. xiv, 1870, p. 282.—Oblong, of the same general outline as *Asida sordida*, but less convex, black, shining. Thorax broader than long, narrowest at apex, sides arcuate, with a slight sinuation near the hind angles, these latter acute, not

prolonged over the humeri, margins slightly explanate and coarsely roughly sculptured, base narrower than the middle, disc convex, quite smooth, a moderately strong impression at middle of base, surface sparsely indistinctly punctate anteriorly. Elytra gradually wider two-thirds to apex, then rapidly narrowed, humeri acute, surface with coarse not closely placed punctures arranged from the suture in eight quite regular series, but at the sides quite confused, at apex smooth; prosternum coarsely deeply and closely punctate, the apex acutely oval; propleuræ smooth. Abdomen coarsely, deeply, sparsely punctate near the base; met-episterna longer than wide, smooth; epipleuræ well marked in their entire length. Length .62--.80 inch.; 15.5--20 mm.

The figure given by Solier of *M. punctata* is a better representation of this new species than of that for which it was intended.

It gives me great pleasure to give to this insect the name of one who has so ably exposed the heteromerous fauna of Mexico and Central America, Mr. G. C. Champion, of London.

Three specimens were collected by the late W. M. Gabb during a journey in the Peninsula of California. The precise locality was not recorded.

**M. polita** n. sp.--Of the same general form as *inæqualis*, but more slender and elongate, piceous black, shining with but few punctures or irregularities above. Head sparsely coarsely punctate, subopaque. Thorax about a third wider than long, sides strongly arcuate, base narrower than at middle, disc convex, a basal depression opposite the scutellum, surface very shining and sparsely punctate, at sides a little more punctate and opaque. Elytra smooth, very sparsely punctate, disc with very vague traces of sulci; epipleuræ well defined; prosternum rather wide, obtuse at tip, coarsely granulate, propleuræ opaque, sparsely punctate; met-episterna fully a half longer than wide. Abdomen shining, sparsely punctate. Legs muricate. Length .60 inch.; 15 mm.

Readily known by its slender form and polished surface.

One specimen kindly loaned by Mr. Chas. Dury, of Cincinnati, collected in Arizona.

**M. inæqualis** Lec., Ann. Lyc. v, p. 129; Lac., Gen. pl. 51, fig. 5; *punctipollis* Lec., loc. cit.--The sides of the thorax are here more arcuate, the hind angles well marked, not prominent, disc convex, closely covered with acute granules, the middle of base depressed; the elytral sculpture consists of intricate elevations with punctate intervals, sometimes there is a vague tendency to form costæ. The entire underside of the prothorax is covered with coarse shining granules, the prosternum moderately wide, the tip oval, sometimes subacute; the met-episterna are nearly as wide as long and granulate; epipleuræ well defined in their entire extent. Length .54--.65 inch.; 13.5—16.5 mm.

Occurs in the southern parts of California, San Diego and eastward.

**M. morata** Horn, Trans. Am. Ent. Soc. vii, 1878, p. 56.—Oval, narrower in front, opaque. Head vaguely and not closely punctate, each puncture with an elongate pale scale. Thorax one-half wider at base than long, narrower at apex, sides feebly arcuate, hind angles prolonged slightly over the humeri, disc convex, without median basal depression, surface moderately closely punctate, each puncture with a scale. Elytra widest behind the middle, convex, the disc with three

feebly defined, short costæ, united by anastomosing lines without distinct punctures in the intervals; propleuræ opaque, sparsely granulate; prosternum coarsely sparsely punctured with semi-erect hairs, the apex oval or subtruncate; epipleuræ well defined. Abdomen coarsely not densely punctate. Length .48–.66 inch.; 12–17 mm.

In some specimens received since the description of the unique, the thoracic punctuation is somewhat irregular, so that there is a tendency to form four smooth spaces, the two anterior spots being closer than the posterior.

Occurs in Grant County, N. Mex., and in Arizona.

**M. sulcipennis** Lec., Journ. Acad. iv, 1858. p. 18; Horn, Trans. Amer. Philos. Soc. xiv, 1870, p. 282, pl. xv, fig. 18.

The specimen described by Dr. LeConte still remains unique. In addition to the characters given by him the prosternum will be found moderately wide and obtuse at tip and with the propleuræ punctate. The epipleuræ are well defined; met-episterna a little longer than wide. Abdomen finely, evenly and not densely punctate. Length .60 inch.; 15 mm.

Llano Estacado, Texas.

**M. robusta** n. sp.—Oval, slightly oblong, dull black, with slight luteous indumentum; labrum with an acute, moderately deep notch. Head sparsely obsoletely punctate, each puncture with a small yellow scale. Thorax one-half wider than long, sides regularly arcuate, hind angles acute, prolonged backward over the humeri, base a very little narrower than the middle of the thorax, disc coarsely moderately closely and evenly punctate, each puncture with a small scale. Elytra very little wider behind the humeri, disc vaguely bicostate, the intervals with intricate elevations; prosternum very coarsely, sparsely punctured, the apex broadly truncate and slightly impressed; propleuræ smooth; met-episterna sparsely punctate, longer than wide; epipleuræ not well defined, except near the base. Abdomen coarsely sparsely punctate, intervals scabrous. Length .56 inch.; 14 mm.

This species resembles a *Branchus* more closely in form than the preceding species; it connects the latter very well with the next species.

It is to be regretted that this species was not found by me in time to have it form a part of the Biologia series, but as the genus is here considered collectively, it has been thought advisable to name it.

Collected by Dr. E. W. Palmer, in Coahuila, Mex.

The following synonymy has been observed:

*Usechus nucleatus* Cas., Ann. N. Y. Acad. Sc. v, 1890, p. 176, is scarcely a variety of *lacerta*.

*Asida angustula* Cas., loc. cit. p. 370, is a male of *muricatula*.

*A. (Pelecyphorus) connivens* Lec., New Species, 1866, p. 110, is the male of *bifurca* Lec., as shown by additional specimens from Lower California.

Typical specimens of the above species have been examined.

**AEGIALITES** Mann.

The first appearance of this name is in the Dejean Catalogue, 1837, p. 131, where it is placed among the Scydmænidæ. The next notice of the name occurs in Bull. Mosc. 1845, i, p. 33, in the following manner:

*Elosoma? californica* M. Noire et luisante, les élytres sont striées par sillons, tronquées à l' extrémité et un peu dehiscentes. Les antennes sont comme chez les Scydmaenus. Serait-ce peut etre l' *Aegialites debilis?*.

The genus *Elosoma* has never been described. *Aegialites* was first quite fully described by Mannerheim, Bull. Mosc. 1853, iii, p. 180, and the species *debilis*. Mannerheim remarks: "I have examined three specimens; one indicated as from California in the cabinet of Motschulsky, another taken at Sitkha by Fred. Sahlberg, and a third collected by Holmberg at Woskresensk bay, peninsula Kenai."

If we can accept the statement of Mannerheim, it is evident that both he and Motschulsky had the same species before them, and that, bad as the description is, *californicus* will, by Mannerheim's admission, have priority over *debilis*.

Recently a species has been collected in California by Mr. Chas. Fuchs differing materially from *debilis*, and in a manner which could hardly have escaped the notice of Mannerheim.

Head and thorax comparatively smooth, the punctures indistinct and sparsely placed; elytra "striato-subsulcate" without distinct punctures; underside of body nearly smooth ..... **californicus.**

Head and thorax coarsely, moderately deeply and rather closely punctate; elytra vaguely subsulcate and with rows of moderately coarse punctures; underside of body coarsely punctate, but sparsely ..... **Fuchsii.**

**Ae. Fuchsii** n. sp.—Oblong, piceous, surface with distinct bluish green lustre. Head moderately closely punctate. Thorax a little wider than long, slightly narrower at apex than at base, widest in front of middle, sides slightly arcuate, disc moderately convex, rather coarsely and moderately closely punctate, median line finely impressed posteriorly. Elytra oval, wider behind, vaguely substriate with coarse punctures moderately closely placed. Body beneath and legs piceous, sides of body and abdomen sparsely punctate. Length .10 inch. ♀; 2.5 mm.; male a little smaller.

In *californicus* the hind tibiæ are quite abruptly bent near the apex, in the present species feebly so. The two species differ considerably in size, *californicus* being nearly twice as long.

Occurs in California, Mendocino County; collected by Mr. Chas. Fuchs, to whom I owe the pair in my cabinet.

**MECROSCAPHA** Lec.

**M. arctica** n. sp.—Oval, convex, a little more acute posteriorly, not twice as long as broad, ferruginous brown, somewhat shining, sparsely clothed with recumbent brown hairs. Head sparsely indistinctly punctate. Thorax sparsely, but regularly punctate, punctures finer in front. Elytra a little more coarsely punctured than the thorax, the punctures sparse and a little more distant near the apex, each having a short hair; scutellum entirely invisible. Body beneath a little paler than above, sparsely pubescent, sparsely punctate, the punctures of the abdomen finer and closer than on the metasternum; mesosternum, as seen between the coxæ, cordiform. Length .09 inch.; 2.25 mm.

This species is larger, more oval and convex than in *clavicornis*, as well as different in color, the latter being piceous. In *arctica* the punctuation is far more distinct, both above and beneath. The following are the essential differences between the species:

Scutellum visible, base of thorax sinuate each side; mesosternum between the coxæ narrow; last joint of maxillary palpi oval, obliquely truncate, longer than wide; eyes moderately coarsely granulate.....**clavicornis.**

Scutellum invisible, base of thorax regularly arcuate; mesosternum between the coxæ cordiform; last joint of maxillary palpi oval, squarely truncate, about as wide as long; eyes very coarsely granulate.....**arctica.**

These characters might be considered generic, but for the present the two species are but associated under one name. Should it be thought advisable to separate the two the name *Crioscapha* may be used for *arctica*.

In the original description of *Microscapha*, Dr. LeConte states that the frontal suture is distinct, but on examination no suture is visible in either of the above species.

Of *arctica*, two specimens were captured at Fort Wrangel, Alaska, by Mr. Wickham, who has kindly presented me with one of them.

## EXPLANATION OF PLATE I.

Fig. 1.—Elytral markings *Galerucella americana.*
" 2.— " " *sexvittata.*
" 3.— " " *integra.*
" 4.— " " *notulata.*
" 5.— " " *notata.*
" 6.— " " *xanthomelæna.*
" 7.—Middle tibiæ ♂ and ♀ of *Phyllecthrus.*
" 8.—Antennæ ♂ and ♀ of *P. gentilis.*
" 9.—Antennæ ♂ and ♀ of *P. dorsalis.*
" 10.—Last ventral segments ♂ and ♀ of *Galerucella cavicollis.*
" 11.—Last ventral segments ♂ and ♀ of *Galerucella americana.*
" 12.—Outline of *Androlyperus fulvus* ♂.
" 13.—Ventral segments of the same.
" 14.—Elytral markings *Diabrotica connexa.*
" 15.— " " *picticornis.*
" 16.— " *Malacosoma vittipenne.*
" 17.— " *Triarius trivittatus.*
" 18.—Head and thorax *Dacoderus striaticeps.*
" 19.— " " " *lævipennis.*
" 20.— " " " *dominicensis.*

## Notes on Bees, with Descriptions of New Species.

BY CHARLES ROBERTSON.

**Sphecodes stygius** ♀.—Black, shining, clothed with thin white pubescence, slightly inclining to fuscous on the vertex and disc of mesothorax; mandibles not dentate, honey-yellow; flagellum testaceous beneath; vertex not tuberculate; disc of mesothorax with coarse, moderately close punctures, rugose anteriorly, metanotum with semi-circular enclosure having coarse reticulations; tegulæ testaceous exteriorly; wings hyaline, slightly dusky towards the tip, nervures and stigma fuscous; apical joints of tarsi dull testaceous; abdomen shining and impunctate at base, becoming more opaque and more punctate on apical segments; first and second segments red, with a fuscous patch on the disc of each, remaining segments black, more reddish laterally, and with broad, dull testaceous, apical margins. Length 5 mm.

♂.—Resembles the ♀; the antennæ darker, not moniliform, third and fourth joints subequal, enclosure of metanotum a little less distinct, tarsi a little paler; abdomen with sides of first, second, and sometimes third segments red. Length 5 mm.

*Hab.*—Illinois; one female, seven male specimens. This species closely resembles *S. mandibularis* Cr., but may be distinguished by its larger size, simple mandibles, more closely punctured mesothorax, darker colored abdomen, and darker tarsi.

**Halictus arcuatus** ♀.—This species closely resembles *H. similis* Sm., and probably has been confused with that species. It is distinguished by its form a little more robust, its clypeus a little less produced; metathorax broader, shorter, rounded posteriorly, instead of being sharply truncate; metanotum more irregularly reticulated; hind spurs with the teeth less obvious; abdomen not so black, a little more punctured, the apical margin more broadly testaceous. Length 7–9 mm.

*Hab.*—Illinois; thirty-five specimens; I think this is the insect identified as *H. similis* by Cresson in his "Hymenoptera Texana." *H. similis* was so named from its resemblance to *H. leucozonius*, a species with sharply truncate metathorax.

**Halictus zonulus** Sm.

Prof. J. Pérez, of Bordeaux, France, has sent me specimens of this species from Europe, with specimens received by him from Canada. He regards them as identical. *H. discus* Sm. is probably this species. The American Entomological Society's collection contains numerous specimens from New Hampshire.

**Halictus parallelus** Say (= *H. occidentalis* Cr.).

Say describes his species as having the "wings and feet ferruginous," which is a sufficient characterization of it. Smith, who evidently never saw Say's species, supposed *H. lerouxii* Lep. to be the

same. It is common in Illinois, and there can be no question about its being the insect found by Say in Indiana.

**Halictus lerouxii** Lep. (= *H. parallelus* Sm. nec Say.)

**Halictus cœruleus** ♀.—Head, thorax and abdomen above of a uniform brilliant blue, smooth and shining, clothed with thin pale pubescence; face broad, clypeus slightly produced, mandibles rufous before apex, antennæ dull testaceous beneath towards tip; mesonotum and scutellum sparcely and finely punctured; metathorax retracted, truncate, the disc with longitudinal raised lines. Wings hyaline, nervures and stigma fuscous, tegulæ piceous. Legs fuscous or dull testaceous, hind spur with three or four teeth. Abdomen shining, almost impunctate, with very thin white pubescence. Length 6 mm.

♂.—Resembles the female; face rounded, clypeus abruptly, but not strongly produced; antennæ moderately long, dull testaceous beneath; the tarsi, and sometimes the knees, pale testaceous. Length 5—6 mm.

*Hab.*—Illinois; four male and five female specimens. It is easily separated from the rest of our *Halictus* by its blue color,

**Augochlora similis** ♀.—Green, the thorax and abdomen more golden, clothed above with yellowish pubescence; labrum, middle of mandibles, flagellum, nervures, stigma and tegulæ, base and apex of tibiæ and tarsi, and narrow edge of abdominal segments testaceous; mesothorax evenly punctured in the middle, reticulate on the sides; metathorax retracted and rounded posteriorly, disc with fine longitudinal lines not reaching the apex, which is smooth and shining. Wings hyaline. Legs dull testaceous, hind spur serrate with numerous fine teeth. Abdomen beneath dull testaceous. Length 4—6 mm.

♂.—Resembles the female; apex of clypeus, labrum, mandibles, except tips and tarsi, whitish; antennæ beneath and tibiæ almost entirely testaceous; fourth ventral segment broadly emarginate. Length 5—6 mm.

*Hab.*—Illinois; nine male, nineteen female specimens. This species is very closely allied to *A. pura* Say. It differs in its smaller size, golden color, in the antennæ, tegulæ, nervures, legs, etc., being more extensively testaceous. The metathoracic striæ do not reach the edge of the truncation, as is commonly the case in *A. pura*. It resembles *A. aurata*, as described by Smith, but the disc of the metathorax has no enclosed space "surrounded by a sharp curved ridge."

**Augochlora labrosa** Say.

This species is common in Illinois. It has abundant characters distinguishing it from *A. pura* and *A. similis*, one of the most obvious being its mesothorax evenly punctured and not reticulated on the sides as in those species. The male is distinguished by the fourth ventral segment not being broadly emarginate as in *A. pura* and *A. similis*.

**Augochlora matilda** ♀.—Green, with bluish and purplish reflections; clypeus produced, sides of face with coarse reticulations, apex of mandibles rufous, flagellum dull testaceous at tip beneath; mesoscutum and scutellum covered with coarse reticulations; metathorax rounded posteriorly, the disc short, shorter than scutellum, hardly longer than post-scutellum, with coarse longitudinal ridges terminating at a waved salient ridge at the edge of the declivity; wings yellowish hyaline; nervures, stigma and tegulæ exteriorly dull testaceous; femora green, tibiæ and tarsi fusco-ferruginous, hind spur serrate with numerous fine teeth; abdomen shining, minutely punctured, with thin pale yellowish pubescence. Length 7 mm.

*Hab.*—Florida; two specimens taken at Inverness, Citrus County.

**Augochlora austrina** ♀.—Green, with bluish reflections; clypeus produced, mandibles rufous at tip, flagellum towards tip testaceous; face above insertion of antennæ evenly punctured, mesoscutum anteriorly shining and slightly rugose, elsewhere evenly punctured; metathorax rounded posteriorly, disc about as long as postscutellum, finely rugose with irregular longitudinal ridges; wings hyaline, slightly dusky towards tips, nervures, stigma and tegulæ testaceous; femora and tibiæ exteriorly greenish, tarsi dull ferrugiuous, hind spur serrate with numerous fine teeth; abdomen minutely punctured, clothed with thin pale pubescence. Length 6 mm.

*Hab.*—Florida; one specimen, taken in Citrus County.

All of the species of *Augochlora* mentioned above agree in having the hind spur serrate with numerous fine teeth and form a distinct section of the genus. Another section, to which belong *A. lucidula* Sm., *A. sumptuosa* Sm. and *A. humeralis* Pttn., is characterized by having this spur provided with four or five long teeth.

**Agapostemon nigricornis** F. (= *Halictus splendens* Lep. = *Agapostemon æruginosus* Sm.)

The male can be separated from other males of the genus known to me by its robust posterior femora, "femoribus posticis incrassatis," Fab., Ent. Syst. ii, 313. I have eight male and female specimens taken in Florida.

**Agapostemon radiatus** Say (*Augochlora radiata* Sm., B. M. Cat. Hym. i, 80 = *Agapostemon pulchra* Sm.).

It is evident that Smith has referred Say's species to *Augochlora* and redescribed it under *Agapostemon*. The male of this species is smaller than that of *A. bicolor*, has the hind femora a little more robust and the metanotum more rugose.

**Agapostemon texanus** Cr.

This species occurs in Illinois. The male may be distinguished from those of the preceding by its white pubescence, and by its metanotum with a distinct triangular enclosure.

**Agapostemon bicolor** ♀.—Head and thorax green, the abdomen black; clypeus produced, black at apex, mandibles at base pale yellow, at tips rufo-piceous; antennæ black, flagellum testaceous beneath; face with confluent punctures, mesoscutum densely punctured, the punctures becoming confluent anteriorly, metanotum less rugose than in *A. radiatus;* wings yellow hyaline, nervures, stigma and tegulæ testaceous, the latter with a pale yellow spot in front; anterior and middle femora black, anterior and middle knees yellow, elsewhere the legs a more or less dull ferruginous; abdomen closely and finely punctured, basal margins of all the segments with dense, appressed, pale pubescence, more or less interrupted in the middle. Length 10—12 mm.

♂.—The male resembles that of *A. radiatus*, but is distinguished by its larger size, slightly more slender femora, its metanotum less rugose. Length 10—12 mm.

*Hab.*—Illinois; a common species.

**Agapostemon tricolor** Lep.

The description gives the ornaments of the males of either of the above the species. An examination of the type would be necessary for its determination. The males of the different species are very difficult to determine, but they show a metathoracic sculpture like that of the females to which they belong. *A. nigricornis*, however, as observed above, can be distinguished by its thickened hind femora.

**Andrena serotina** ♀.—Black, clothed with thin pale ochraceous pubescence; clypeus finely roughened, hardly shining, with large, sparse punctures; basal process of labrum subtriangular, broadly truncate at tip; mandibles at apex rufous, flagellum beneath dull testaceous; mesonotum finely roughened, with sparse, shallow punctures; enclosure of metanotum large, rather coarsely reticulated. Wings fulvo-hyaline; nervures, stigma and spot on tegulæ testaceous. Legs, especially the tarsi, fusco-ferruginous. Abdomen minutely roughened and finely punctured, apical margins of segments pale testaceous, 2–4 slightly depressed and bearing interrupted fasciæ of whitish pubescence; anal fimbriæ fulvous. Length 7—8 mm.

♂.—Head broader than thorax, clypeus shining, finely and sparsely punctured, thinly pubescent, apex strongly produced and widely emarginate at tip; mandibles long, decussate, rufous at tip; flagellum testaceous beneath, cheeks strongly produced behind the eyes and surrounded by a carinate border, vertex nearly carinate; tegulæ more testaceous than in female. Legs dull ferruginous, tarsi testaceous. Abdomen fusco-ferruginous, shining, margins of segments pale testaceous, but hardly fasciate. Length 7 mm.

*Hab.*—Illinois; six females and three male specimens. The female resembles *A. flavo-clypeata* Sm.

**Andrena scutellaris** ♀.—Black, pubescence beneath pale ochraceous, above inclining to fulvous, especially on the scutellum and post-scutellum, where it is dense and bright; clypeus shining and impunctate medially, rather closely punctured and thinly pubescent laterally; basal process of labrum subtriangular, broadly rounded at tip; mandibles rufo-piceous at apex; antennæ black; mesonotum minutely roughened, almost impunctate, clothed with thin, pale, fulvous

pubescence, the scutellum posteriorly and post-scutellum with rather long, bright fulvous pubescence; enclosure of metanotum reticulated at base. Wings fusco-hyaline; nervures, stigma and tegulæ dull testaceous. Legs black, apical joints of tarsi ferruginous. Abdomen finely roughened and feebly punctured, apical margins of segments narrowly pale testaceous, with thin fasciæ of pale pubescence, anal fimbria fuscous. Length 8 mm.

♂.—Resembles the female, the pubescence a little paler; the clypeus yellow, with a triangular black spot on each side; basal process of labrum subquadrate, shorter than broad. Length 5—7 mm.

*Hab.*—Florida; twenty-six female, eight male specimens. This species closely resembles *A. flavo-clypeata* Sm., but may be distinguished by its darker wings, fulvous pubescence, etc.

## The Phalangida Mecostethi of the United States.

BY NATHAN BANKS.

The Mecostethi (Laniatores) have two claws to each of the four posterior tarsi, or else a compound claw; the Plagiostethi (Palpatores) have one simple claw to the tarsus of each leg. Two families of the Mecostethi have been recorded from the United States in the following literature:

Say.—An Account of the Arachnids of the United States, Journ. Acad. Nat. Sci. 1821; Complete Writings, LeConte.

Tellkampf.—Beschr. ein neu i. d. Mammuth-Höle in Kentucky aufgefund. Gattung. v. Gliederthieren, Arch. f. Naturgesch. 1844.

Cope.—On the Wyandotte Cave and its fauna, Am. Nat. 1872.

Simon.—Opiliones Mecostethi, Ann. Soc. Ent. Belg. 1879.

Hubbard.—Two days' collecting in the Mammoth Cave, etc., Am. Ent. 1880.

Packard.—New Cave Arachnida, Am. Nat. 1884.

Packard.—The Cave Fauna of North America, etc., Nat. Acad. Sci. 1887 (?)

The two families may be separated as follows:

Hind pair of coxæ free at apex, spiracles obscure.....PHALANGODIDÆ.
Hind coxæ wholly united to the venter, spiracles distinct.....COSMETIDÆ.

Our species of Cosmetidæ apparently belong to one genus, which has some of the characters of *Cynorta*, and some of *Vonones*. As *Cynorta* is the older and best known, I adopt that name for them. The eye-tubercle is almost obliterated, with only a few small granules, the eyes widely separated, the legs short and tarsus I with five joints. The palpi have the second joint short, concave within; the third still shorter, widest at tip; the fourth longer than the others, with the sides flattened; the fifth short, with a long claw. The palpi are usually appressed to the face, so as to cover the mandibles. The three species known to me are separable as follows:

Two acute spines near end of dorsal shield.....**ornata.**
Two rounded tubercles instead of spines.....**Sayii.**
Neither spines nor tubercles.....**bimaculata.**

**Cynorta ornata** Say.

This species is found in the southeastern part of the United States, usually under rotten logs. The young are lighter colored, and with long, slender palpi.

**Cynorta Sayii** Simon.

This was described as *ornata* Say by Wood, but is plainly a different species. It is usually without the white lines on the dorsum that are so common in *ornata*. It ranges somewhat more northward than that species, extending up to Kansas. It is found under and among dead leaves.

**Cynorta bimaculata** n. sp. Length 4 mm.; width 2.9 mm.; femur IV 2.5 mm.—Color: dorsum brownish red, with two long, somewhat lunate white spots near the end of the dorsal shield; venter red. Legs yellowish, marked with fuscous toward their tips. Body finely granulate, without large tubercles or spines; hind margins of the posterior segments furnished with a row of small tubercles. Legs 4-2-3-1; femora III and IV curved; patellæ and tibiæ III and IV roughened.

A smaller species with shorter legs than the other two. San Diego, Cal.; given me by Dr. Geo. Marx.

The Phalangodidæ are represented by four genera:

But one compound claw to each of the four posterior tarsi; palpi not as long as the body.....**Sclerobunus.**
Two simple claws to each posterior tarsus.
Eye-tubercle pointed, arising from the anterior margin; palpi shorter than the body.....**Sitalces.**
Eye-tubercle arising from the middle of the cephalothorax; palpi as long as body.
Second joint of palpi more than three times as long as wide; legs very long.
**Phalangodes.**
Second joint of palpi about twice as long as wide; legs much shorter.
**Scotolemon.**

**Phalangodes** Tellk.
*Acanthocheir* Lucas.
*Phrixis* Cope.

This differs from *Scotolemon* in having much longer legs and more slender palpi. We have two species:

Eyes none, no spines on body; cave form.....**armata.**
Eyes present, spines on body, non-cavernicolus.....**spinifera.**

**Phalangodes armata** Tellk.
*Phrixis longipes* Cope.
Mammoth Cave, Kentucky.

**Phalangodes spinifera** Pack.

Southern Florida.

**Scotolemon** Lucas.

*Phalangodes* Simon et Packard (in part).
*Erebomaster* Cope.
*Ptychosoma* Sorer.

**Scotolemon flavescens** Cope.

This was described from Wyandotte Cave; it has since been found in caves in Virginia and Kentucky. What I consider as the same species occurs under stones on the Virginia shore of the Potomac near Washington, D. C. This out-of-door form does not differ much from cave specimens; there are three quite large projections near the base of the second joint of palpi. All the forms vary in the number of tarsal joints. Some cave specimens are blind, and form the variety *cœcum* Pack.; others from Weyer's Cave are darker and spotted, and form the variety *weyerensis* Pack.

**SITALCES** Simon.

This genus is given by Simon to two species from the Isle of Reunion; a form from California seems to belong to the genus, or else it will form a new genus closely allied to *Sitalces*.

**Sitalces californica** n. sp. Length 2 mm.—Color yellow, venter paler, legs whitish towards the tips. Body oval, truncated in front, rounded behind; cephalothorax about twice as wide as long, the suture separating it from the abdomen obsolete at the sides, the surface finely granulated, with a few larger granules near the meson and some on the posterior sides. Eye-tubercle large, arising from the anterior margin, about one-half the length of the cephalothorax, much roughened and finely granulated; eyes near the base of the tubercle. Anterior segments of the abdomen united, finely granulated and with about six transverse rows of larger granules or tubercles, somewhat irregular on the anterior sides, the posterior rows larger than the anterior; beyond are three transverse scutæ or segments, connected by a yellowish membrane; these have a row of tubercles on their posterior margin, and the last scuta also a row on its anterior margin; seven finely granulated scutæ on the venter. Palpi with the first joint short; second more than twice as long, with three projections below, roughened above; third short, gradually enlarged from base to tip, with two projections above and one below; fourth longer than the third, with two large projections below and several short ones above; fifth joint shorter and smaller than the fourth, about as long as the third, with two projections below, the claw at tip long and stout; all the projections tipped with stiff hairs as usual. Legs short, finely roughened with many short hairs.

One specimen has a large spine on the hind trochanter. Southern California.

**SCLEROBUNUS** gen. nov.

Each of the four posterior tarsi has but one claw, which has on its sides one or two curved projections. The palpi are shorter than the body, and the dorsal shield shows traces of the basal abdominal segments. The eye-tubercle is rounded, situated near, but not quite upon, the anterior margin. Otherwise the genus is similar to *Scotolemon*. *S. robustus* is the type; two species are known to me.

Color red, tips of legs black ..... **robustus.**
Color brown, tips of legs yellowish ..... **brunneus.**

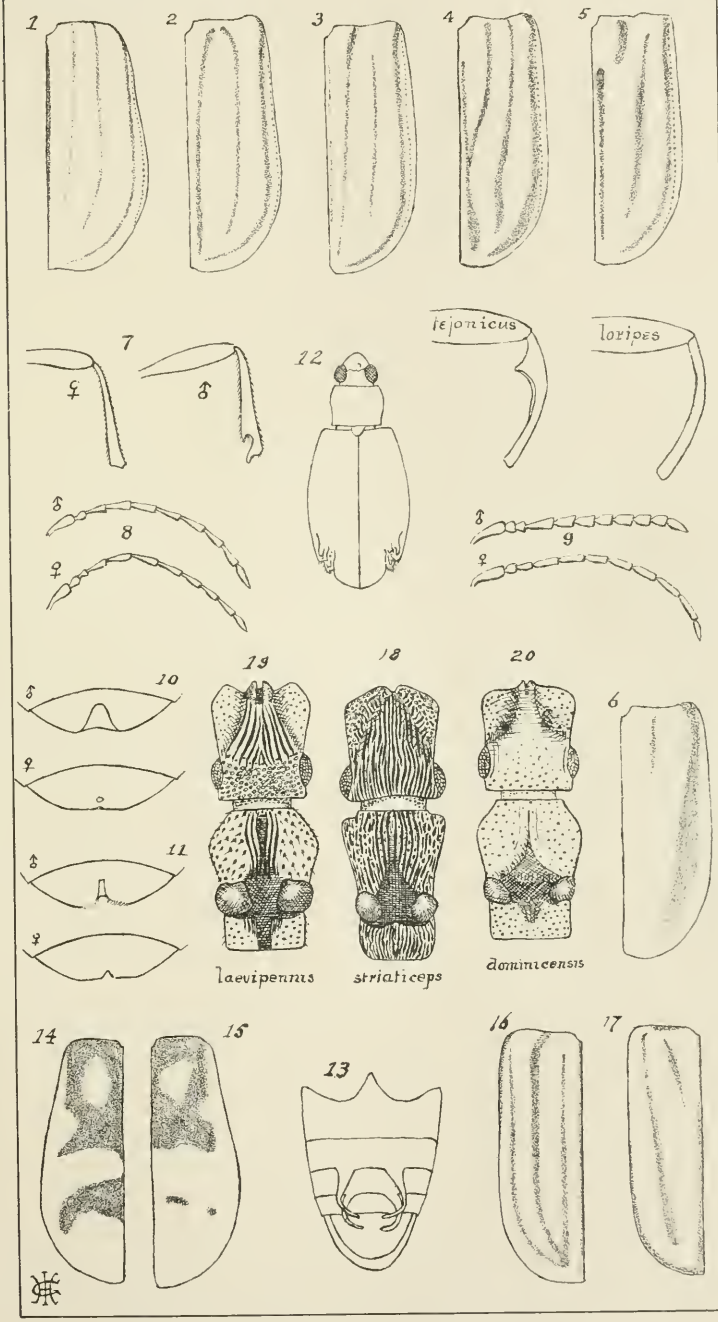
**Sclerobunus robusta** Pack.

Packard first described this under the genus *Scotolemon*, afterward referred it to *Phalangodes*. His figure of the palpus on Plate XII (Cave Memoir) is poorly drawn, there being no third joint represented. The figure in the text (Cave Memoir, p. 48) is probably that of a male, the female has the second joint of the palpi less gibbose than the male. The four posterior claws have one large projection each side. The anterior femora have three or four little tubercles, tipped with a stiff hair.

It was described from Utah. I have it from Colorado and Washington State (Trevor Kincaid).

**Sclerobunus brunneus** n. sp. Length 2 mm.--Color brown, paler on the cephalothorax; legs brown, a little darker than the body, their tips yellow; palpi yellow; venter brownish yellow. The eye-tubercle is rounded like *robustus*, a little closer to the anterior margin than in that species. The dorsum and legs have many little tubercles, each tipped with a stiff hair or bristle. These are quite prominent on the tibiæ and patellæ of the legs; there are two of these tubercles near the base of femur I. The palpi are very short, not half the length of the body; joint two is not as enlarged as in *robustus*, about twice as long as wide, and with two short projections below; joint four is barely longer than wide, and has two projections below; joint five is nearly as long as joint two, and has four or five projections below; the claw is nearly one-half as long as the joint. The legs are very short; leg I not as long as the body, femur II not as long as the cephalothorax is wide. The four posterior claws have two curved projections each side.

Washington State (Trevor Kincaid).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2
3
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7
♀
♂
12
lejonicus
loripes
♂
8
♀
♂
9
♀
10
♂
♀
11
♂
♀
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laevipennis
striaticeps
dominicensis
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# CATALOGUE OF THE ODONATA (DRAGONFLIES) OF THE VICINITY OF PHILADELPHIA, WITH AN INTRODUCTION TO THE STUDY OF THIS GROUP OF INSECTS.

BY PHILIP P. CALVERT,

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(Plates II and III).

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Such eminent authorities as the Baron de Selys-Longchamps, Prof. Uhler and Mr. McLachlan, have at different times expressed the opinion that the number of species of Dragonflies is decreasing, at least in well-settled districts. The causes for this decrease are probably to be found in the pollution of the waters in which the nymphs live, and the filling up of ponds which formerly served as centres of propagation. Such being the case—and it is also true of other groups of animals—it seems advisable to bring together in permanent form such records as exist of the dragonflies of Philadelphia and its neighborhood, of their times of appearance, and of other biological facts concerning them. While such a descriptive catalogue as the present would be of greater value if it treated of a larger area, yet too large a proportion of the species of the Eastern United States, for instance, remain personally unknown to the writer to render such an extension advisable.

The data upon which the present Catalogue is based are—specimens in the collection of the American Entomological Society, collected chiefly by Mr. S. F. Aaron, and in that of the Wagner Institute of Science by Mr. C. W. Johnson; those gathered by Dr. Henry Skinner and Messrs. C. W. Johnson, Philip Nell and Philip Laurent, and generously placed by them at the writer's disposal; while the principal source has been the writer's own observations made in Delaware County, Pennsylvania, during the Summers of 1886–93. For the years 1888–92, a record was made each day for each species observed, but other occupations prevented continuous daily observations, so that future observers will probably add much to the facts here given.

The scope of this Catalogue is set forth on page 266. In defining the major groups and the genera, the endeavor has been to so state their respective characters as to separate them from all other groups of like rank wherever found, and not merely with reference to North American forms. While not as much can be claimed for the specific definitions, yet there, too, a similar attempt has been made; these throughout have been newly drawn up from specimens, except in the few cases noted in the text where such were not available. Only selected references to previous descriptions of species are given, in view of the existence of the synopses of Dr. Hagen and Mr. Banks. The classification of the Calopteryginæ, Agrioninæ, Gomphinæ and Cordulinæ follows very nearly, although often in reverse order, the latest published views of Baron de Selys, and of the Aeschninæ, those of Dr. Karsch, while a new arrangement of the Libellulinæ has been employed.

The distribution of each species is given in full, and the information on this subject will, in many cases, be found to greatly exceed that already published. That it has been possible to do this is owing to the labors of collectors who have submitted their specimens to the writer for examination, and whose results have not, save in two or three cases, been published. Such are the collections made by Miss Mattie Wadsworth, at Manchester, Me.; Mrs. A. T. Slosson, at Franconia, N. H., and in Florida; Miss A. M. Sharp, in Tama Co., Iowa; by Messrs. J. P. Moore, at York Harbor, Me., Lake St. Regis, N. Y., and with D. J. Bullock, in the Bahamas; Prof. F. L. Harvey, at Orono, Me.; W. Sheraton, Pictou, N. S.; P. C. Truman and E. S. Cheney, S. Dakota; Prof. E. T. Owen, Dane Co., Wis.; J. F. Schafer, Mt. Pulaski, Ill.; F. S. Jones, Chincoteague and Assateague Is., Va.; E. V. Beales, Denver, Col.; G. D. W. Williamson, Dobb's Ferry, N. Y.; C. C. Adams, Bloomington, Ill.; A. L. Babcock, Sherborn, Mass.; T. D. A. Cockerell, Las Cruces. N. Mex.; A. Davidson, M.D., Los Angeles, Calif.; W. D. Richardson, Fredericksburg, Va.; H. L. Walker, Belvidere, Ill.; G. Miller, York, Pa.; Prof. O. B. Johnson, Seattle, Wash.; F. H. Hillman, Reno, Nev.; W. J. Fox, Jamaica; E. F. Hitchings, Worcester, Mass.; C. W. Johnson, Dover, N. J., and Great Wicomico River, Va.; Michigan and Colorado Agricultural Colleges; and by the writer in the White Mts., N. H., Saratoga, N. Y., and Sea Isle, N. J.

From time to time the writer has been requested to name such books as would serve as introductions to the study of this group of

insects. It has not been possible to answer such questions satisfactorily, owing to the lack of any work, in English at least, which treated of the structure and development of the Odonata, save in a brief and general way. Part I of the present paper is intended to supply this deficiency, and, by mentioning those topics on which present knowledge is insufficient or wanting, to suggest subjects for investigation. It has been taken for granted that those who will use it are already acquainted with the structure of insects in general and the technical terms used in connection therewith, to at least the extent contained in the introductory chapters of Comstock, or of Packard, or in the papers on "Elementary Entomology" contributed by the writer to *Entomological News* from May, 1890, to April, 1891; and in treating of the embryonic development a knowledge of the elementary facts of embryology is presumed. While free use has been made of the existing literature in its preparation, by far the larger portion of Part I is based on personal dissections, and some details are introduced which are believed to be new, *e. g.* the descriptions of the cephalic muscles (pp. 171–2), main tracheæ (p. 179), development of the skeleton of the nymph (pp. 195–8), and the view of the phylogeny of the subfamilies (pp. 211–214).

The writer is indebted to his brother, Mr. Frederic B. Calvert, for the table on page 208. As stated in the text, this table is based on Mr. Kirby's Catalogue, but it is highly probable that many of the species contained therein will hereafter prove to be mere varieties, so that the figures in the table rather overstate the facts.

Valuable aid has been rendered by Mr. Chas. W. Johnson in supplying specimens and dates; by Dr. G. H. Horn, in comparing specimens of *Diplax* with the types in the Museum of Comparative Zoology at Cambridge, Mass.; by Mr. Samuel Henshaw, in a similar way for *Aeschna clepsydra* and *Libellula exusta* in the same museum; while Mr. H. F. Moore opportunely presented the nymph of *Calopteryx maculata* (afterwards raised to an imago) figured in part on Plate II, fig. 8.

Fig. 2 is after Walsh, figs. 33 and 34 are copied from Korschelt and Heider's Lehrbuch; all the others are original.

Biological School,
University of Pa.,
Philadelphia, Sept. 19, 1893.

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For correction of an error in the text, see page 226, foot-note *

# PART I.

## A GENERAL ACCOUNT OF THE ODONATA.

### Names and Definition.

The insects technically known as the Odonata have received the popular English names of Dragonflies, Darning-needles, Bad-man's-needles, Devil's darning-needles, Snake doctors, Mosquito hawks and Horse-stingers. Some of these names testify to that widespread, but quite unfounded belief in the harmfulness of these creatures to man, which is by no means yet extinct.

Philip Andreas Nemnich, in his Allgemeines Polyglotten-Lexicon der Naturgeschichte, article Libellula, has brought together many popular names of the dragonfly in various languages, especially from the German. A selection is added: German, *Wassernympfe, Wasserjungfer* (water maiden); French, *demoiselle;* Spanish, *Nadadora;* Portugese, *Mosca que da grandes picadas* (fly with the great stings); Italian, *Cevettone, Saetta* (arrow); Dutch, *Juffer, Scherpstekendevlieg* (sharp-sticking-fly) (McLachlan); Danish, *Guldsmed;* Swedish, *Trollsianda.*

In the classification of Linnæus, the dragonflies appear as the genus *Libellula* of the order Neuroptera. Fabricius was the first to apply to them the name *Odonata** (Ent. Syst. ii, p. vi, 373, 1793), to designate his fifth 'Classis' of the Insecta. Subsequent writers have variously regarded the group as a family or as a suborder, either of the Neuroptera or of the Pseudoneuroptera, retaining the Fabrician name. Still other, and for the most part later authors regard the Odonata as an order of the Ametabolous, Hemimetabolous or Homomorphous series of Insects.

The zoological characters of the Odonata are:

Insects with an incomplete metamorphosis. Alimentary canal without cæca. Seven pairs of abdominal ganglia. Malpighian tubules numerous (50–70).

*Imago.*—Head of conspicuous size, its prothoracic articulation very mobile; antennæ short, awl-like (subulate); eyes large; three ocelli; biting mouth-parts, labium proportionately large. Prothorax

* Greek Ὀδους, ὀδοντος (odous, odontos), a tooth, referring presumably to the toothed mandibles.

much smaller than the other two thoracic segments, which are closely united to each other; tarsi of three joints; wings large, flat, membranous, many-veined, of nearly equal length, furnished with an opaque pterostigma on the front margin near the apex. Abdomen of ten distinct and one anal segment, terminated with a pair of unjointed, dorsal appendages. Males with the external opening of the testes on the ventral surface of the ninth abdominal segment, penis and accessory genital organs on the ventral surface of the second segment, and one or two terminal, inferior, abdominal appendages. Females with the vulva at the ventral apex of the eighth abdominal segment, no inferior, terminal abdominal appendages.

*Nymph* (i.e. the form from egg to imago) aquatic; labium (mask) of large size, protractile, and functioning as a seizing organ. Respiration by tracheal gills.

The divisions here recognized are:

Order ODONATA.
- Suborder Zygoptera.
  - Family Agrionidæ.
    - Subfamily Calopteryginæ.
    - Subfamily Agrioninæ.
- Suborder Anisoptera.
  - Family Aeschnidæ.
    - Subfamily Gomphinæ.
    - Subfamily Cordulegasterinæ.
    - Subfamily Aeschninæ.
  - Family Libellulidæ.
    - Subfamily Cordulinæ.
    - Subfamily Libellulinæ.

They are defined in Part II.

## 1. Structure of the Imago.

### THE SKELETON.

The most prominent external features of the Odonata are the large size of the head and its distinctness from the rest of the body, the compact thorax bearing the powerful and many-veined wings, and the length and slenderness of the abdomen.

Of the **head** (Pl. II, fig. 11), by far the most conspicuous parts are the *eyes*. Even in those forms (Agrionidæ) in which they occupy the relatively smallest area of the head, their proportionate size is only occasionally equaled in other groups of animals. In all

the Odonate groups, the eyes occupy the lateral parts of the head, being mainly restricted to that region in the Agrionidæ, and there the head is transversely elongated; reaching farther towards the mid-dorsal line in the Gomphinæ, meeting at a single point on the top of the head in the Cordulegasterinæ; finally, in the Libellulidæ and the Aeschninæ being connected for at least some little distance, and here the head is globose. It is in various genera of the Aeschninæ that their connection is proportionally greatest, and the eyes themselves relatively largest, and these same genera include those species whose flight is most powerful.

The facets are hexagonal in shape, and where the eyes meet dorsally, those of the upper surface are larger than those of the lower. In such cases a gradual transition in size from one to the other exists, but in many Libellulinæ the facets of about the upper third of each eye are distinctly marked off in size from the lower ones, the line of separation being nearly horizontal. Below this line a gradual difference in size downwards is found. In life the color of the eyes is darker above and becomes paler below.

The *epicranium* occupies a very large part of the area of the head. In the Agrionidæ, it completely separates the eyes from each other, but is itself divided into right and left halves except at the vertex, frons, and for a short distance above the posterior foramen. This division is made—beginning at the frons and proceeding forwards, downwards, backwards and upwards—by the clypeus, labrum, mouth parts, gula, posterior foramen and occiput. The occiput, however, although distinct in the Anisoptera, appears to be so completely fused with the epicranium in the Zygoptera that no sutures are visible.

Names have been applied to different parts of the epicranium. The most dorsal portion, and especially the region of the ocelli, is the *vertex*. Between the vertex and the clypeus is the *frons;* the place of insertion of the antennæ may be considered to mark its posterior boundary. Since each eye is encircled by epicranium, that portion lying between the eye and the clypeus and mouth-parts is the *gena*. Lastly, the hindermost part of the head is simply referred to as the *rear of the head*, or the *rear of the eyes;* the right and left halves of this part unite with each other above the posterior foramen and below the occiput, but the uniting suture is usually obliterated. On either side of the posterior foramen is a groove in which glides a tubercle of the prothorax to furnish the articulation of head and thorax.

The preceding description of the parts of the epicranium applies to the Agrionidæ and the Gomphinæ, except that in the latter the occiput is separated by distinct sutures in front and on either side, but behind it fuses with the epicranium. In the remaining groups, where the eyes meet in a greater or less extent on the top of the head, the area of the epicranium is much reduced. Little remains of the vertex, except that part included between the ocelli, which is elevated and often characteristically shaped in different genera; it is the *frontal vesicle* of some authors. The genæ are almost entirely obliterated. The frons is bent on itself at an obtuse angle so that two surfaces may be distinguished, one horizontal (superior surface), the other more or less vertical (anterior surface). Behind the eyes the epicranium continues to occupy a considerable area.

The *ocelli* are three in number, placed upon the vertex in the form of an isosceles triangle with its apex directed forwards. The anterior ocellus is the largest of the three.

The *occiput* is situated at the upper, median, posterior portion of the head from the vertex backwards and downwards to a short distance above the posterior foramen, which latter it does not reach. As already mentioned, it is entirely fused with the epicranium in the Zygoptera, but is more or less distinct in the Anisoptera. It presents two more or less distinct surfaces, one dorsal, the other posterior; where these are sharply separated, as in the Gomphinæ, the separating margin (referred to as "hind margin," or simply "margin") frequently offers specific characters.

The *gula* is membranous and extends from the posterior foramen to the submentum.

The *clypeus* (*epistoma*) is wider than high. A division into *ante-* (*infra-*) and *post-* (*supra-*) *clypeus* exists, the former having received the special name of *rhinarium*, the latter that of *nasus;* they form an obtuse angle with each other in the Zygoptera, but lie more nearly in the same plane in the Anisoptera.

The *labrum* is of moderate size, elongated horizontally, its basal margin nearly straight, its free edge rounded.

The *antennæ* are quite short, bristle-like, and are inserted on the epicranium between frons and vertex. Each consists of at least four joints, of which the basal is usually thickest and shortest. The remaining joints successively decrease in thickness, their comparative length varies in different genera.

The *mandibles* are moderate in size, but strong, and toothed on the inner (opposed) surface. The apex ends as a sharp point, on both anterior and posterior sides of which is an acute tooth. Separated by an interval from this apical group of teeth, is a toothed basal portion, suggesting, as Rambur remarked, a molar. In surface view, this is a **Z**-shaped ridge. If the top of the **Z** be considered to be that lying nearer the apex of the mandible, then the upper angle of the **Z** lies next the anterior surface of the mandible, that is, the **Z** looks backwards. At each of the two angles, and at each of the two free ends of the **Z**, the ridge is elevated into an acute tubercle.

The stem of the *first maxilla* is composed of two joints of which the basal is the *cardo*, the distal, about twice as long, is the *stipes*. Articulated to the distal end of the stipes are two separate pieces, each consisting of a single joint. The outer is much the slenderer, of simple form, clothed with hairs, is curved inwards and backwards, and ends in a fairly acute apex; it is the *maxillary palpus*. The inner piece is flattened from behind forwards; its inner edge bears six long spines and some long hairs; it corresponds to the galea and lacinia (outer and inner lobes of the maxilla) fused together (Gerstaecker 2*).

Various views have been held as to the composition of the *labium* or *second maxillæ*. It will be sufficient to mention only two here. An examination of Pl. II, fig. 7, will be necessary to properly understand the text.

By Rambur (33), and in the earlier writings of Hagen, the median portion of the labium (*ml*, fig. 7) was regarded as representing the inner and outer lobes of the labium, that is a fusion of the glossæ and paraglossæ, while each lateral portion (*ll*) was held to be merely the labial palp.

Gerstaecker (2) holds that *ml* is a fusion of merely the inner lobes (glossæ), while *ll* is composed of a union of an outer lobe (paraglossa) and a labial palp. Graber (Die Insekten I, p. 130, fig. 186) accepts Gerstaecker's view, but piece *s*, which Gerstaecker calls the *squama*, he regards as half of the mentum; hence *m*, the "mittelstück" of Gerstaecker, or *subglossa*, has come to lie between the right and left halves of the mentum.

For the sake of convenience, de Selys' usage will be followed here, and the middle portion, *ml*, be designated as the *median lobe*, and each lateral part, *ll*, as the *lateral lobe*. The median lobe is bifid at its extremity in the Agrionidæ, some Gomphinæ, and the Cordulegasterinæ; it is entire in the other groups, in the Aeschninæ a me-

* These figures after authors' names refer to papers named in the bibliography with which Part I concludes.

dian impressed line recalling the primitively bifid condition. The form of the lateral lobes varies in the different groups, and is proportionally largest in the Libellulidæ. The terminal joint (*tp*) of the lateral lobe of the Agrionidæ, in either of the above views, is the terminal joint of the labial palp ; it is also present in the Aeschnidæ, but is wanting in the Libellulidæ.

A *hypopharynx* is present as a median organ of moderate size, hairy, and broader at its free end.

*Endoskeleton of the head.* Near the centre of the hind surface of the head is a foramen—the *posterior cephalic*—by which the cavities of head and thorax communicate. The foramen is divided by a transverse chitinous rod (*a*) into an upper and a lower half. Through the upper division passes the alimentary canal, vessels, tracheæ, etc., through the lower the ventral nerve cord. From either end of this rod (*a*), where it joins the margins of the posterior foramen, another chitinous rod (*b*) extends forwards and upwards inside the skull to the roof of the head, where frons and vertex meet. Near its lower extremity, rod (*b*) is connected with a chitinous shelf (*c*) which separates the cavity of the frons above from that of the clypeus below. A foramen, whose plane slants from behind downwards and forwards, is thus formed in the centre of the head ; its margins are rod (*a*) behind, rod (*b*) on either side, and shelf (*c*) in front. Through this foramen the alimentary canal passes downwards to the mouth, and in so doing, is surrounded by the circumœsophageal nerve-ring. In those groups where the eyes do not meet on the top of the head, the epicranial cavity extends backwards between the right and left orbital cavities, being separated from them by membrane. Where the eyes meet dorsally, the cavity of the epicranium is confined to the front of the head and is made up for the most part by the frons, whose cavity is shut off from those of the orbits by a membrane stretched from one side of the frons to the other and strengthened by the two rods (*b*), and the orbital cavities lie side by side, although separated by an incomplete, superior, chitinous partition.

Of the three segments of the **thorax** (Pl. II, fig. 13) the *prothorax* is much the smallest and least specialized, and is much less intimately related to the mesothorax than the latter is to the metathorax. Its dorsum is transversely divided into three successive areas, called by Rambur, the anterior, median and posterior lobes. The median lobe is usually the largest, and is marked by a longitudinal impression ; the front and hind lobes are usually not impressed. The shape

of the hind lobe varies in different species and sexes of the Agrioninæ, and in different genera of the Libellulinæ. The pleura are quite distinct and consist of two or three sclerites. At its anterior edge each pleuron bears a rounded tubercle which slides in a groove on the side of the posterior cephalic foramen. The sternum is of moderate size; the first coxæ are placed near its hind end. Internally, on the floor of the prothorax are two chitinous projections, between which the nerve-cord runs; these, as well as some dorsal, downwardly-directed processes, also serve for muscular attachments.

The remainder of the thorax is characterized by its general obliquity and the close union of meso- and metathorax. The obliquity is due to the great development of the *mesepisterna* which meet each other on the mid-dorsal line, in front of the tergal sclerites of the same segment.* In consequence, the words "dorsum" and "tergum" applied to the thorax have very different meanings. "Dorsum of the thorax," as used by descriptive writers on the Odonata, and as used in this paper, includes the mesepisterna and the meso- and metathoracic terga, that is, all those sclerites which make up the back of the thorax. So, also, "sides of the thorax" is equivalent to the pleura of meso- and metathorax, *less* the mesepisterna. The terga of these two segments taken together are often referred to as the interalar space. Each tergum is made up of scutum, scutellum and postscutellum, in the Agrionidæ at least, while the præscutum is absent, or at least not externally visible, in the view of Packard (1).

The suture at which the two mesepisterna meet on the dorsum is usually raised into a ridge, the *mid-dorsal thoracic carina* (arete mésothoracique, Rambur). Each mesepisternum terminates on its outer side at the *humeral suture*, present in all Odonata, running from beneath the base of the front wing to the hind edge of the second coxa. A short distance above the second coxa, a transverse suture runs to the anterior opening of the mesothorax, so that a sclerite is formed between the anterior mesothoracic opening on the inside, the humeral suture on the outside, the second coxa below and the transverse suture above—known as the *mesinfraepisternum*.

It is apparently only in the Calopteryginæ that the suture separating meso- and metathorax is complete on the sides of the thorax.

* Such is Packard's (1) view. Walsh (Proc. Ent. Soc. Phila. II, p. 217, 1863) previously advanced the same opinion. Brauer, however, holds (Verhd. k. k. zool.-bot. Gesell. Wien xci, p. 355, 1885), this dorsal part to be mesothoracic prescutum. See the discussion in the text, *post*.

In the members of that subfamily, in front of the metastigma, a suture is to be seen a short distance behind the humeral suture, starting, likewise, from beneath the base of the front wing, and meeting the humeral suture behind the second coxa. This suture is the *first lateral suture* of Rambur, and the space between it and the humeral suture is the *mesepimeron*. Following and parallel to the first lateral suture in the Calopteryginæ is the *second lateral suture*, from beneath the base of the hind wing to the rear of the third coxa. From near its lower extremity a short curved suture passes to the front of the third coxæ, so that a *metinfraepisternum* is formed, corresponding in position to that of the mesothorax. The space between the first and second lateral sutures is the *metepisternum*. Behind the second lateral suture the *metepimeron* extends ventralwards to the sternum, with which it is apparently fused in front, but from which it is separated for the most part by the longitudinal *latero-ventral metathoracic carina*.

The mid-dorsal thoracic carina and the first lateral suture thus correspond, and so also the humeral and second lateral sutures.

In some Calopteryginæ (e. g. *Rhinocypha*), and in the other subfamilies, the greater part of the first lateral suture is obliterated, only the lower part up to about the level of the metastigma, and sometimes the upper extremity (e. g. *Lestes*), remaining. Thus mesepimeron and metepisternum form a single piece.

The interpretation of the thoracic pleura here given, which is essentially that of Packard (1), as against those of Brauer and Walsh, seems justified by the metameric arrangement of the wing muscles. Brauer (*l. c.*) holds that what are above regarded as the mesepisterna are really the prescutum of the mesothorax. An examination of the wing muscles (see the description, *post*, and Pl. II, figs. 12, 13), will show that both as regards its relation to the other pleural sclerites, and to the position and origin of the muscles of the front wing, the mesepisternum is the homologue of what is above termed the metepisternum.* Walsh, however (Proc. Ent. Soc. Phila., II, pp. 269, 270), regarded the division between meso- and metathorax as marked by the second lateral suture, while the first lateral suture he termed "false," or "supernumerary." To this it may be replied that the position of the first lateral suture corresponds to the line of separation between the muscles of front and hind wings, the arrangement of which muscles is so clearly metameric (fig. 12, being that of an *Aeschna*, cannot show the first lateral suture as it is obliterated).

The *mesosternum* is relatively small, and lies between and in front of the second coxæ. The *metasternum* is probably all that area

* Compare also the development of the mesepisterna, *post*.

lying between the right and left latero-ventral metathoracic carinæ, and extending from the first abdominal sternum to between the third coxæ.

Internally, at each of the sutures separating the pleural sclerites, is a chitinous ridge (*apodeme*), resulting from an infolding of the integument, to serve for muscular attachment. A development of apodemic processes and the fusion thereof, forms, on the floor of the mesothorax and of the anterior part of the metathorax, a tunnel (*neural canal*) for the ventral nerve-cord.

The pattern of the external coloring of the thorax conforms in the main to the pleural sutures, and by reference to those sutures, the precise location of stripes may be indicated. Thus, very frequently a stripe covers the humeral suture, and is consequently referred to as a "humeral stripe;" an "ante-humeral stripe" is approximately parallel to, but to the inner (mid-dorsal) side of the humeral suture.

Two pairs of spiracles, or stigmata, exist in the thorax. The *mesostigmata* are situated on the lower part of each mesepisternum, close to and somewhat above the margins of the anterior mesothoracic opening; they are often partly concealed by the overhanging of the prothorax. The *metastigmata* lie, one in the lower part of each metepisternum, and are very distinct in all the Odonata.

The *legs* do not present any wide range of variation. Their length successively increases from the first to the third. The second and third are placed closer together than are the first and the second. If the legs be extended in the position natural to the insect when at rest, four faces may be distinguished in the limb—viz.: superior, inferior, anterior and posterior. The terms exterior and interior, as applied by some authors, correspond to the superior and inferior faces, respectively. The coxa is fairly robust and short. The trochanter is longer, constricted near the middle so as to frequently present the appearance of a suture, and its articulation with the femur is oblique. While usually smooth, the trochanter may become spinous (*Gomphus*). The *femur* and the *tibia* constitute by far the greater part of the leg. The former is the stouter and usually the shorter. Both are characterized by the possession of two principal longitudinal rows of downwardly directed, divergent spines, of which one divides the anterior face from the inferior, the other the posterior face from the inferior. The relative size of these spines may be nearly the same on femur and tibia (*Calopteryx*), or those on the

tibia may be much longer (*Aeschna*, *Libellula*). When the spines of both tibial rows are fairly similar in shape, those of the anterior row may be more numerous on the first legs and less numerous on the second and third (*Calopteryx*, *Lestes*, *Libellula*), or more numerous on the first and third and of equal number on the second legs (females of *Cordulegaster*). On the other hand the spines of the anterior row may be replaced by knobs on the second and third tibiæ (most males of *Cordulegaster*), or on all the tibiæ (males of *Cordulegaster diastatops*). The number of tibial spines, and the relation existing between their length and the intervals separating them, have yielded generic characters in the Agrioninæ and Libellulinæ. When the femoral spines are shorter than those of the tibia, each of the two primary rows may become a double or a triple row (*Cordulegaster*). Moreover, superior longitudinal rows of spines may be developed on the femur (*Aeschna*), or on the tibia (*Gomphus*). The *tarsus* consists of three joints, increasing in length distally in all living Odonata ; the fossil Calopterygine *Tarsophlebia* has the basal joint as long as the second and third joints together. Each joint bears two rows of spines, continuations of those on the tibia. The terminal joint bears a pair of acute, divergent, tarsal nails, each of which has usually an acute tooth on the lower side ; the position of this tooth varies in different groups. A minute process occurs between the two nails at their bases.

After remarking the apparently disproportionate size of the legs in an insect which uses them so little for locomotion, McLachlan suggests that "the greatest service all the legs render is possibly in enabling the creature to rest lightly so that it can quit a position of repose in chase of passing prey in the quickest possible manner." (Encyc. Brit. 9th ed. art. Dragonfly). The first pair of legs are usually employed to hold the food as it is devoured.

The *wings* are prolongations of the integument of the meso- and metathorax between the tergum and pleuron. Of the two laminæ of which they are formed, the upper is tergal, the lower pleural. The wings are large, membranous and many-veined. The front wings are usually about one millimetre longer than the hind wings ; the latter are of equal width with the former at the base, in the Zygoptera, but distinctly wider in the Anisoptera. The arrangement of the veins offers many characters for classification, as well as affording a means for exactly locating wing-markings. Inasmuch as the homologies of the veins in different orders of Insects have not

yet been established, the nomenclature here used will be that of de Selys and Hagen.

At the base of each wing are five large longitudinal veins, whose names, beginning at the front margin, are *costa*, *subcosta*, *median*, *submedian* and *post-costa*. At the basal extremity of the costa is a thickening, the *anterior axillary callus*, and a similar *posterior axillary callus* lies at the base of the median and submedian veins. The structure of the base of the wing and of the adjoining thoracic region has been described and figured by Lendenfeld (4) with a minuteness of detail into which it is not necessary to enter here.

The costa coincides with the front margin of the wings from base to apex; at a varying distance from the base it curves in and then out again forming a wide, but distinct angle. At this point a short, thick cross-vein exists—the *nodus*. Parallel to the costa and next below it is the subcosta, running from the base, but stopping at the nodus, except in a few exotic forms. Below the subcosta and parallel to it is the median vein, the third of those which start from the base of the wing; upon reaching the nodus, it bends upwards towards the costa, next below which it continues to the apex of the wing. Between the median and submedian veins, at the extreme base of the wing is the *basilar space* (*upper basal cell* of Kirby), usually not crossed by veins, and whose apical boundary is a straight or broken cross-vein, the *arculus*. From the apical side of the arculus, two longitudinal veins arise, the *upper* and *lower sectors of the arculus*. The space between the submedian and post-costal veins is the *median space* (*lower basal cell*, Kirby), and the area between post-costa and the hind margin of the wing is the *post-costal space*.

Thus far the description given will apply to all the Odonata. For the further arrangement of the veins, it will be necessary to refer to certain groups separately. If the wing of any North American Odonate, other than a Calopterygine, be examined, it will be seen that the median vein does not give rise to any longitudinal veins, but that four conspicuous longitudinal veins are given off, directly or indirectly, from the upper sector of the arculus. These four veins are from above downwards—1. the *principal sector*, immediately below and parallel to the median vein; 2. the *nodal sector*, which parts from the principal at or near the nodus; 3. the *subnodal sector*, parting from the principal some distance on the basal side of the origin of the nodal; 4. the *median sector* (to be carefully distinguished from the median *vein*), whose point of separation from the principal lies on the basal side of that of the subnodal.

If the distribution of these veins be now compared with that of such a Calopterygine as *Calopteryx* or *Hetærina*, it will be seen that the principal and subnodal sectors apparently arise from the median vein, but a closer examination will show that the principal sector here also arises from the upper sector of the arculus by a short vein which runs from the upper sector (at a short distance from the arculus) obliquely upwards and outwards to the median vein, thence alongside of, and in contact with it, then again separating and continuing on its course as already described for the other groups. The subnodal sector parts from it in the region of its contact with the median vein, while the nodal sector is unchanged. This arrangement of the principal sector does not prevail among all Calopterygiuæ; in many exotic genera the positions of principal and subnodal sectors is as described for the order in general, and even some individuals of *Calopteryx* show a complete separation between principal sector and median vein.

De Selys and Hagen have considered the principal vein to extend from the arculus to the apex of the wing, but for the sake of convenience, it is here proposed to regard the principal sector as beginning at the point of its separation from the median sector, and to designate the vein from the arculus to that point of separation, as the upper sector of the arculus.

The lower sector of the arculus is quite constant in position, and runs behind and fairly parallel to the median sector. It is also termed, or at least as much as lies beyond certain areas hereafter described as the quadrilateral or the triangle,—the *short sector*.

The *quadrilateral* is a space on the wings of the Zygoptera, bounded by the lower sector of the arculus, the submedian vein, a cross-vein between these two, and the lower part of the arculus. It may or may not be cross-veined, but in the former case, the cross-vein which forms its outer (distal) boundary is thicker than any of the veins within. Beyond the quadrilateral, the submedian vein is prolonged as the *first* or *upper sector of the triangle*. The post-costa extends outwards below and parallel to the submedian as far as the outer side of the quadrilateral; its prolongation is the *second* or *lower sector of the triangle*.

In the Agrioninæ, Baron de Selys has considered the lower sector of the triangle in some genera as "arising in front of the basal post-costal nervure (see fig. 1)." It would seem more correct, judging from a comparison with the Calopterygiuæ, to say "the post-costal vein separating from the hind margin in front of," etc.

In the Anisoptera, an area will be seen occupying nearly the same position as the quadrilateral in the Zygoptera. This is the *hypertrigonal*, or *supratriangular space*, for the reason that it is immediately above a distinctly triangular area, *the triangle*, *discoidal triangle*, or *cardinal cell*. Lying on the basal side of the triangle is frequently another triangular area, the *internal triangle* or *subtriangular space*. The sectors of the triangle arise from or near the lower angle of the triangle; on the outer side of this last between the short sector and the upper sector of the triangle is a varying number of rows of cells—the *post-triangular cells* or *discoidal areolets*.

Between the two families of the Anisoptera a difference exists in the triangle of the front wings. In most Aeschnidæ the triangles of front and hind wings are similar in size and shape. In the Libellulidæ the triangle of the hind wings remains similar to that of the Aeschnidæ with its longer axis parallel to the long axis of the wing, but in the front wings it is elongated from above downwards, so that its long axis is at right angles, or nearly so, to the long axis of the wing.

The lower boundary of the supratriangular space is formed by a vein broken into two parts at the point whence the inner (basal) side of the triangle diverges. Walsh (Proc. Ent. Soc. Phila. II, p. 208) held that of these two parts, the basal one corresponds to the lower side of the quadrilateral of the Zygoptera, the distal part to the outer side of the quadrilateral, and that the supratriangle and quadrilateral are homologous. Consequently the outer side of the triangle would be the homologue of a cross-vein between the short sector and the first of the triangle in the Zygoptera; the upperside of the internal triangle would be the correspondent of the downward prolongation of the apical side of the quadrilateral, while that side of the internal triangle nearest the anal angle would be a portion of the second sector of the triangle of the Zygoptera.

On the other hand De Selys had earlier stated (Mon. Calopt. p. 279, 1854) that the quadrilateral corresponds to the triangle and supra-triangle taken together, and that the distal part of the lower boundary of the supra-triangle is a "superior branch of the submedian vein" which is wanting among the Zygoptera. From this view it would follow that the outer side of the triangle is homologous with the apical (outer) side of the quadrilateral, the inner side of the triangle is a part of the lower side of the quadrilateral, and in either view, is a prolongation of the submedian vein and continued by the upper sector of the triangle; finally, the side of the internal triangle nearest the anal angle is a part of the post-costal vein.

The difference between these two views depends upon the homology recognized for the "upper branch of the submedian vein." The view of De Selys is here adopted for the two following reasons:

1. The apical side of the quadrilateral is a convex vein, a condition satisfied by the outer side of the triangle, but not by the "upper branch of the submedian vein."

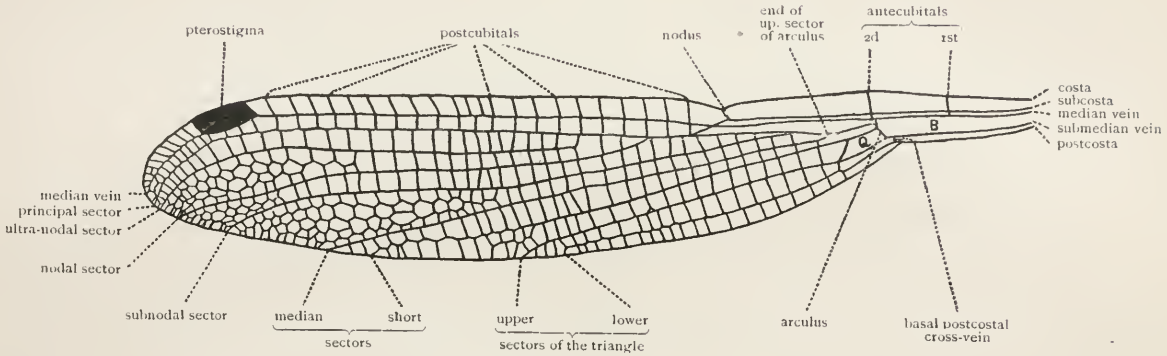



Fig. 1.

Front wing of *Orthol*estes *clara* Calvert (Ent. News, II, p. 199, 1891), from Jamaica, to illustrate the venation of an Agrionine.

B,f basilar space. Q, quadrilateral. Seven antenodal cells are shown. Supplementary sectors are shown between the ultra-nodal and the nodal, the nodal and the subnodal, and the subnodal and the median sectors.

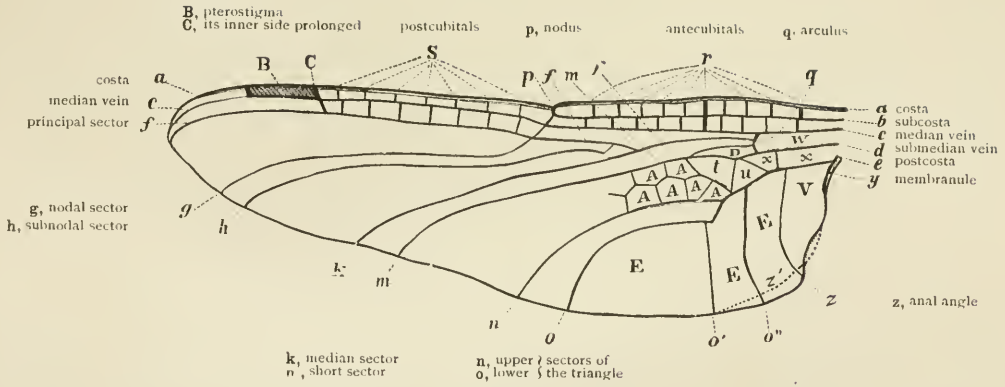



Fig. 2.

Hind wing of a *Gomphus* ♂ (after Walsh).

(By errors in the original engraving the first antecubital of the first series is incorrectly shown as not being entirely coincident with the first of the second series, and the sectors of the triangle ought to have been shown as arising from its lower angle.)

A.....A, three, then two rows of post-triangular cells. D, supra-triangular space. E, E, E, post-costal space. t, triangle. u, internal triangle. V, anal triangle. W, basilar space. x, x, median space. z', dotted line showing outline of anal margin in the female.

2. The wings of the fossil Gomphine genus *Stenophlebia*, as they are figured by Hagen (Paleontographica, X, taf. xiii, figs. 4, 5, 6; XV, taf. xi, fig. 2, taf. xiii, fig. 1) strongly favor such a homology.

The "upper branch of the submedian vein" perhaps arose as a quadrilateral cross-vein which became more and more oblique until it formed the upper side of the triangle, while at the same time the apical (outer) side of the quadrilateral increased in length, carrying the submedian vein and its prolongation, the upper sector of the triangle, farther and farther downwards towards the post-costa and its continuation, the lower sector of the triangle.

The wings are not perfectly flat, but are folded longitudinally* in such a way that the chief veins lie either on the crest of ridges, or at the bottom of valleys (*convex* and *concave* veins of Adolph). Looking upon the *upper* surface of the wings, the costa, median vein, subnodal sector, lower sector of the arculus (short sector) post-costal vein and lower sector of the triangle are convex veins, while the subcostal vein, upper sector of arculus, principal, median and nodal sectors, submedian vein and upper sector of the triangle are concave veins. As Lendenfeld pointed out, this folding of the wings prevents their being bent in a direction at right angles to their surface and a consequent loss of effectiveness as the wings strike the air.

Two characteristic features of Odonate wings are the pterostigma and the membranule. The *pterostigma* is an opaque, colored area between the costa and the median vein near the apex of the wing. It fills usually one cell (*true* pterostigma) or sometimes several cells (*false* pterostigma). It is occasionally absent (some Zygoptera), and in one instance present, but not touching the costa (*Anomalagrion*).

The *membranule* is an opaque area at the anal margin, lying outside the veined portion of the wing, absent or rudimentary in the Zygoptera, of variable size in the Anisoptera.

Of the numerous cross-veins to be found in the wings of the Odonata special names have been applied as follows: *antecubitals* (*antenodals* Kirby) are cross-veins between the costa and median vein, and the base and the nodus, and of which there are two series —those between costa and subcostal, and those between subcostal and median veins; those of the first series may or may not coincide in position with those of the second.

NOTE.—The term *antenodal* or *discoidal cells* has also been applied by de Selys and is used here (see *Enallagma* in the Catalogue, *post*) to denote those cells in the Agrioninæ situated between the short sector and the first sector of the triangle, and the outer side of the quadrilateral and the cross-vein which descends from the nodus. They are, therefore, the homologues of the post-triangular cells of the Anisoptera, but this distinctive name is convenient.

* This folding is but slight, and does not admit of the wing being closed upon itself, as in the Orthoptera, for instance.

*Post-cubitals* (*post-nodals* Kirby) are cross-veins between the costa and the principal sector, and the nodus and the pterostigma, and of which there are similarly two series.

*Basilars, supra-triangulars* and *median cross-veins* cross respectively the basilar, supra-triangular and median spaces. The *basal post-costal vein* (Selys) in the Agrioninæ is a median cross-vein. *Subcostal cross-veins* is the term applied by Karsch to cross-veins confined to the space between subcostal and median veins and on the basal side of the first antecubital.

In addition to the veins and sectors which have already been described, there exist between them near the hind margin of the wing, varying numbers of more or less parallel *supplementary, interposed sectors*. Of these the chief one between the principal and nodal sectors has received the name of *ultra-* or *post-nodal*.

Redtenbacher, in his paper on the wing-veins of insects (Ann. k. k. Naturhist. Hofmus. Wien I, pp. 153–231, 1886), numbers the veins of the Odonate wing as follows: I costa, II subcosta, $III_1$ median vein, $III_2$ principal sector, $III_3$ ultra-nodal sector, IV nodal sector, V subnodal sector, VI median sector, VII short sector, VIII upper sector of the triangle, IX lower sector of the triangle.

While the anal margin of the hind wings is usually convex and the anal "angle" rounded, in the males of many Aeschnidæ and of the Cordulinæ the anal margin is concave, and the angle present. De Selys has shown that this concavity is correlated with the presence of a denticulated tubercle (*auricle*) on either side of the second abdominal segment, and suggests that the hollowing out of the anal margin prevents tearing the wing on the auricular teeth, as would be the result were the anal margin convex. No such concavity of the anal margin is present in the corresponding females, as even when auricles occur in this sex, they are much smaller and not denticulated.

The **abdomen** consists of ten distinct segments, and a terminal tubercle with the anal opening (*anal segment, telson*). It is convenient to designate the abdominal segments from base to apex, by the figures 1 to 10; of these 1 is always the shortest. The exoskeleton of each segment consists of a large dorsal sclerite (tergum), forming an arc much greater than 180°, which overlaps and partly hides the much smaller sternum. Tergum and sternum are connected by a pleural membrane on either side, which allows of the distension and contraction of the segment in the act of respiration. In most of the groups a longitudinal ventral carina is present near each pleural

margin of the terga. In the Aeschninæ and in the Libellulidæ a longitudinal lateral carina is developed on either side of the terga, and distinctly separates the dorsal from the ventral surface of the abdomen. A longitudinal mid-dorsal carina frequently occurs. A transverse carina is present near the base and near the apex of each abdominal segment of most Odonata and, as well as the other carinæ, is frequently denticulated. Additional transverse carinæ occur in some Libellulinæ (*Pantala*, *Tramea*, etc.) and additional longitudinal carinæ in some Aeschninæ (*Anax*). The sternum of the first segment is a simple, usually flat piece, whose lateral margins are more closely united to the tergum than in the succeeding segments. On either side is a stigma (spiracle). The sterna of 2–9 are elongated pieces narrowing posteriorly, having on each side, near the anterior end one or two processes directed outwards and upwards, whereof the anterior is the slenderer. Lying in the pleural membrane, a short distance behind the second lateral sternal process, is a spiracle in 2–8. The sternum of 2 is modified in the males in consequence of the existence of ventral accessory genital organs at that place. The external orifice (*vulva*) of the oviduct in the females is situated at the apex of the sternum of 8, and the posterior margin of that sternum is known as the *vulvar lamina*. The ninth segment has no spiracles; its sternum, in the males, is pierced by a median opening for the vas deferens, which opening is guarded by two small chitinous flaps, one on either side; in the females it is entire, and may be variously bent or grooved in different forms. The sternum of 10 is very small or wanting.

The apex of the abdomen of the males is provided with two *superior*, and one (Anisoptera) or two (Zygoptera) *inferior*, unjointed, chitinous *appendages*, whose function is to clasp the prothorax of the female in copulation and often during oviposition. Their shape is usually characteristic for the species. The cavity of the superior appendages is continuous with that of the tenth segment, to which they belong. The pair of inferior appendages of the Zygoptera belong to the anal segment or telson, the anus opening between them; the single median inferior appendage of the Anisoptera belongs to the same segment the anus lying in a tubercle (anal segment) beneath the appendage.

A secondary sexual modification presented by the males of most Aeschnidæ and of the Cordulinæ, is a pair of protuberances (*auricles*), one on either side of 2, and which are usually denticulated.

Correlated with their presence, as already mentioned, is the excavation of the anal border of the hind wings. In the females of many Gomphinæ, rudimentary, non-denticulated auricles exist.

The abdomen of the females is terminated by two unjointed dorsal appendages, belonging to the tenth segment, and therefore homologous to the superior appendages of the males. Their shape varies but little in different Odonata, and they are not known to perform any function. The anal segment lies below the appendages.

The accessory genital organs of the male and the vulvar lamina of the female will be described in connection with the reproductive organs.

## THE MUSCLES.

The muscles of the Odonata are well developed, usually consisting of a number of fasciculi. Their attachments, whether of origin or insertion, may be direct or by tendon. The tendons are chitinous, and are usually of one of two kinds; in the one, the tendon is dark-colored and forms a stalked, abruptly flattened cup, to whose concave surface the muscle fibres are attached; in the other the tendon is pale in hue and conical in shape, receiving the muscle fibres at its wider end.

Where possible, the muscles described below have been identified from the general description of insectan muscles by Burmeister (32), and from Lendenfeld (4), Poletaiew (5), and Plateau (11). The chief species which has served for this account is *Aeschna constricta* Say, but comparisons have also been made with *Calopteryx* and *Libellula*. Only the most important muscles are included.

**Cephalic muscles.**—The muscles which move the entire head are very small. They arise from the anterior part of the mesothorax, and from the prothorax, and insert near the margins of the posterior cephalic foramen. Those dorsally placed elevate the head and draw it backwards, while the ventral ones depress it; the lateral ones draw it to either side.

*Abductor labri* (Burm.) arises by flat tendon from point of union of frons and vertex, passes downwards immediately behind and in contact with the posterior border of the shelf (*c*) separating the clypeus from the frons, and inserts without a tendon, into the base of the labrum close to the middle line; it elevates the labrum; the right and left abductors lie side by side.

*Adductor labri* (Burm.) arises in common with, but on the outer side of the abductor of the same side, but forms a distinct belly and inserts in the membranous roof of the mouth behind the labrum, and farther from the middle line than the preceding; it draws the labrum downwards and backwards.

*Adductor mandibulæ* (*flexor mandibulæ* Burm.) large, fan-shaped, arising from the upper part of the posterior surface of the head from near the mid-dorsal line

to more than half way down on the eye-margin, inserts by a strong, flat tendon into the inner side of the base of the mandible, which it draws towards the middle line.

*Abductor mandibulæ* (*extensor mandibulæ* Burm.) is considerably smaller than the preceding, on the outer side of which it lies, taking origin from the rear of the head near the margin of the eye and below the most external part of the origin of the adductor; it inserts by a round tendon into the outer part of the base of the mandible; it draws the mandible away from the middle line.

*Adductor primus maxillæ* (*flexor primus maxillæ* Burm.) is the largest of the maxillary muscles; it rises by a cap-like tendon from the rear of the head near the posterior foramen and inserts into the cardo and the inner margin of the stipes; with the following it draws the maxilla towards the middle line.

*Adductor secundus maxillæ* (*flexor secundus maxillæ?* Burm.), a strap-like muscle, arises from the rear of the head behind the adductor mandibulæ, passes within the stipes, and inserts by a small, pale tendon into the inner side of the base of the galea-lacinia.

*Abductor maxillæ* lies between the preceding and the abductor mandibulæ; its fibres arise from the rear of the head in a line running from the inner side of the origin of the abductor mandibulæ to the origin of the adductor secundus; they insert into the outer side of the cardo and draw the maxilla away from the middle line.

*Flexor galeæ* (Burm.) rises from the outer side of the stipes and inserts into the base of the galea-lacinia. Still smaller muscles are the *extensor galeæ* and the *flexor* and *extensor palpi*.

At least three pairs of muscles may be distinguished in the labium; they may be best examined by transmitted light in labia which have been cleared in clove-oil or similar reagent. All three aid in closing the labium.

*Adductor labii* (Burm.) arising from the lower margin of the posterior cephalic foramen, inserts into the distal end of each half of the submentum (*sm* fig. 7, pl. II).

*Submentalis* arises from the submedian and inserts into piece *s* (fig. 7, pl. II). Its fibres are superficial to those of the preceding.

*Adductor ligulæ* arises from the submentum, distal to the origin of the submentalis and inserts into the base of piece *m* (fig. 7, pl. II). Its fibres are apparently in the same plane as those of the adductor labri.

**Thoracic muscles.**—The muscles of the legs require no special notice.

The *wing-muscles* are large and well-developed. Their arrangement (see fig. 12, pl. II) is the same for the hind as for the front wings. Arising on or near the floor of the thorax, they pass upwards and insert on the wing-bases. The fulcrum on which each wing moves is furnished by a pleural process, shown in fig. 13, pl. II, immediately above the humeral and the second lateral sutures, respectively. It may here be designated the *fulcral process*. The muscles which elevate the wing are placed nearest the middle line of the thorax, and their insertions on the wing-base *inside* of the

fulcral process. The depressor muscles are to the outside of the elevators, while their insertions lie *without* the plane of the fulcral process. Elevation of the wing is by the operation of a lever in which the fulcrum lies between the points of application of the power and the weight, but close to the former. In depression of the wing, the fulcrum is at one end of the lever, the power being applied near to, but outside it. Lendenfeld (4) has determined the total weight and the area of the wings of some European Odonata as follows, from which the relative wing area per .1 gram. has been ascertained.

| | Total weight in grammes. | Total area of wings in square centimetres. | Relative wing area in square centimetres per .1 gram. of body weight. |
|---|---|---|---|
| Aeschna cyanea ♂ | .92 | 11.45 | 1.2445 |
| Libellula cancellata ♂ | .44 | 7.04 | 1.6 |
| Libellula quadrimaculata ♂ | .29 | 5.54 | 1.91 |
| Agrion puella | .026 | 1.10 | 4.23 |
| Calopteryx virgo ♂ | .1 | 5.56 | 5.56 |

Ramon y Cajal found (Intern. Monatschr. Anat. u. Phys. v, p. 267, 1888) the nuclei of the wing muscle fibres to be central, large, and elongated; cross-sections showed radiations from the nucleus to the sarcolemma. In the fibres of the leg muscles, the nuclei are peripheral. Some additional details by the same author are contained in Zeit. Wiss. Mikros. vii, p. 335, 1890.

### Muscles of the Front Wings:

*Anterior depressor of the front wings* (abductor alæ primæ Lendenfeld, abaisseur antérieur Poletaiew) rises on the anterior part of the mesinfraepisternum and the lower part of the mesepisternum; it inserts by a cap-tendon into the anterior axillary callus a little in front of the costa and of the fulcral process. Lendenfeld states that this muscle is "extraordinarily feeble in *Calopteryx*;" it is not so in *C. maculata*.

*Accessory of the anterior depressor* (pronator radii primi Lend., additionnel au abraisseur antérieur Pol.), a very small muscle, arises from the lower part of the mesepisternum near the infraepisternum, and lies upon the middle of the outer side of the anterior depressor; at about one-third its length the belly passes into a slender cap-tendon, which inserts close to and on the outer side of the insertion of the anterior depressor.

*Posterior depressor of the front wings* (flexor alæ primæ Lend., abraisseur postérieur Pol.) rises from the hind part of the mesinfraepisternum and the lower part of the mesepimeron, and inserts by a cap-tendon into the pleural membrane of the base of the wing, below the median vein.

*First accessory of the posterior depressor* (additionnel postérieur au abaisseur postérieur Pol.), a small muscle, lies on the outer and hinder side of the posterior depressor, arising from the metepisternum just behind the apodeme of the rudimentary first lateral suture and above the origin of the accessory of the anterior depressor of the hind wings: it inserts by a very slender tendon into the wing-base below the post-costa.

*Second accessory of the posterior depressor* (flexor radii quinti Lend., additionnel antérieur au abaisseur postérieur Pol.) is larger than the preceding, on the inner side of which it lies, and is on the hinder part of the posterior depressor; it arises from the lower part of the mesepimeron behind the origin of the posterior depressor, and inserts by a cap-tendon into the wing-base below the post-costa, almost side by side with the first accessory.

*Principal elevator of the front wings* (tensor alæ primæ Lend., élévateur Pol.) is a large muscle close to the middle line of the thorax and behind the anterior depressor; its origin is from the top of the mesothoracic neural canal and from the inner side of the second coxal opening, and inserts by a more powerful cap-tendon than that of any other muscle of this wing, on the extreme inner wing-base from the costa to the median vein. A small muscle extends from its tendon of insertion to the fulcral process.

*Anterior accessory elevator of the front wings* (pronator alæ primæ Lend., additionnel antérieur au élévateur Pol.) lies between the principal elevator on the inside, the posterior depressor on the outside, the anterior depressor in front, and the posterior accessory elevator behind; it arises from the upper, outer margin of the second coxal opening, and inserts by a cap-tendon into the wing-base below the costa; the level of its insertion is not as far forward as that of the anterior depressor. The tendon of this muscle is not cap-like in *Calopteryx*.

*Posterior accessory elevator* (supinator alæ primæ Lend., additionnel postérieur au élévateur Pol.) is behind the preceding; it takes origin from the upper, outer margin of the second coxal opening immediately behind the origin of the anterior accessory elevator; it inserts by a pale tendon into the wing-base below the subcosta.

*Adductor radii quinti alæ primæ* (Lend.) arises from the mesonotum opposite the level of the median vein, and inserts at the base of the post-costa. In front of this muscle is the insertion of the posterior accessory elevator, behind it are the insertions of the two accessories of the posterior depressor and on its outer side is the insertion of the posterior depressor.

### Muscles of the Hind Wings.

*Anterior depressor of the hind wings* (abductor alæ secundæ Lend., abaisseur antérieur Pol.) arises from the inner, anterior part of the metinfraepisternum and the apodeme between the second and third coxæ; it inserts by a cap-tendon into the front edge of the anterior axillary callus, a little in front of the costa and of the fulcral process.

*Accessory of the anterior depressor* (pronator radii primi alæ secundæ Lend., additionnel au abaisseur antérieur Pol.) is a very small muscle, arising by tendon from the lower, anterior part of the metepisternum, very close to the apodeme of the rudimentary first lateral suture; its belly is short, terminating in a slender cap-tendon which inserts in the wing-base immediately external to the attachment of the anterior depressor.

*Posterior depressor of the hind wings* (flexor alæ secundæ Lend., abaisseur postérieur Pol.) arises from the hind part of the metinfraepisternum and the adjacent part of the metepimeron, inserts by a cap-tendon into the pleural membrane of the wing-base below the median vein.

*First accessory of the posterior depressor* (additionnel postérieur au abaisseur postérieur Pol.) a small muscle, lies a short distance behind the preceding, arising by tendon from the hind margin of the metasternum, and inserting by a pale tendon into the wing-base below the sub-costa.

*Second accessory of the posterior depressor* (flexor radii quinti alæ secundæ Lend., additionnel postérieur au abaisseur postérieur Pol.) lies on the inside of the preceding and behind the posterior depressor; it arises from the lower, anterior part of the metepimeron near the metinfraepisternum, and inserts by a cap-tendon into the wing-base below the post-costa, and immediately on the inside of the insertion of the first accessory, than which muscle it is somewhat larger.

*Principal elevator of the hind wings* (tensor alæ secundæ Lend., élévateur Pol.) takes its rise from the sides of the metathoracic neural canal and inserts by a very short, powerful cap-tendon into the extreme inner wing-base from costa to median vein. Like the elevator of the front wings, it has a small muscle reaching from its tendon of insertion to the fulcral process.

*Anterior accessory elevator* (pronator alæ secundæ Lend., additionnel antérieur au élévateur Pol.) arises from the outer upper margin of the third coxal opening, and inserts by a cap-tendon into a process on the wing-base below the costa and behind the level of the insertion of the anterior depressor.

*Posterior accessory elevator* (supinator alæ secundæ Lend., additionnel postérieur au élévateur Pol.) arises immediately behind the anterior accessory elevator and inserts by a pale tendon into a process on the wing-base below the subcostal.

*Adductor radii quinti alæ secundae* Lend. arises on the metanotum opposite the median vein and inserts on the post-costa.

The relative positions of the muscles of the hind wings are the same as for those of the front wings, and are shown in fig. 12, pl. II.

Each wing, therefore, whether front or hind, has three elevators, five depressors and one adductor. Certain of these acting by themselves produce different effects than mere elevation or depression. Thus, the anterior depressor moves the wing horizontally forwards, the adductor horizontally backwards; moreover, the surface of the wings may be somewhat slanted from one plane to another.

The position of the first lateral suture corresponds to the line of separation between the muscles of the front and of the hind wing, the arrangement of those of the latter repeating that of the former.

Other thoracic muscles than those of the legs and wings are

*Auxiliary sterno-dorsal* rising from the outer side of the hind end of the metathoracic neural canal by tendon, and inserts by tendon into the tergum of the first abdominal segment; it lies close to the middle line and acts as an extensor of the abdomen, in connection with the superior tergal abdominal muscles.

*Submedian ventral thoracico-abdominal* arises with its fellow of the opposite side from near the mid-ventral line of the metasternum, and inserts into the middle of the anterior margin of the first abdominal sternum. It is a flexor of the abdomen in connection with the sternal abdominal muscles, with which it is perhaps homologous.

*Lateral thoracico-abdominal*, with its fellow of the other side, arises by a common tendon from the roof of the metathoracic neural canal; the bellies separate, diverge, run backwards and insert by a pale tendon into the side of the anterior margin of the first abdominal sternum; together they act as an abdominal flexor, separately to pull the abdomen to that side.

The **abdominal** muscles are longitudinal and transverse. The longitudinal muscles are tergal and sternal. Of the longitudinal tergal there are two sets: the *superior longitudinal tergal abdominal* muscles pass from the anterior dorsal part of the tergum of one segment to the same posterior part of the next in front; the *lateral longitudinal tergal abdominal* muscles pass from the inferior lateral margin of the tergum of one segment and the adjacent pleural membrane to a region somewhat higher up on the tergum of the preceding segment. The *longitudinal sternal abdominal* muscles are quite small, and pass from the anterior part of the sternum of one segment to the posterior part of the preceding sternum. The contraction of the superior tergals of both sides is to extend the abdomen in a straight line, of the sternals of both sides to flex the abdomen ventrally upon itself, while a contraction of the muscles of one side of the abdomen only will bend it towards that side. *Transverse* muscles occur in the second abdominal segment of the males from tergum to sternum; and in the spiracle-bearing segments as *vertical expiratory* muscles (Plateau 11) connecting the terga with the second lateral sternal process, and which aid in the contraction of the abdomen in the act of expiration.

## THE ALIMENTARY CANAL.

The alimentary canal is a nearly straight tube running from the mouth on the lower surface of the head to the anus in the rudimentary eleventh, or anal segment. It consists of three parts: the *fore-*, the *mid-*, and the *hind-gut*. The first and last are formed from the ectoderm of the embryo, like the integument, and have a chitinous lining; the mid-gut is of endodermal origin and the chitinous lining is absent.

The fore-gut (œsophagus and crop) extends from the mouth to the second abdominal segment. Its walls are very distensible, particularly at its hinder end. Its only appendages are a pair of *salivary glands*, which were discovered and described by Poletaiew (9). The glands are compound, and lie in the prothorax. Each acinus is tolerably long and narrow; their number is greater in the Anisoptera (above 150) than in the Zygoptera (50), and in the former group they are more closely bound together by a tracheal net-work. The acini of each gland eventually form a single duct, which dilates into a reservoir, after which it unites with its fellow of the other side. The common opening is on the underside of the hypopharynx, where

it joins the labium. The development of the salivary glands begins in a late nymphal stage.

The mid-gut (chylific ventricle) extends from the second to the hind part of the seventh abdominal segment. Its walls are thicker than those of the fore-gut, and are transversely ringed. The opening between the fore- and the mid-gut is valvular, so formed by the hind end of the fore-gut extending a short distance into an invagination of the front end of the mid-gut. There are no appendages (cæcæ) to the mid-gut. Faussek (7) has described the histological structure of the mid-gut. The epithelium consists of high, very narrow, cylindrical cells, and does not form folds; between these cells are many fairly large glands (crypts) whose cell-nuclei, in contradistinction to those of the epithelium proper, show mitosis. External to the epithelium is a structureless membrana propria, then in succession outwards, a circular muscle, a connective tissue and a longitudinal muscle layer. This description applies to the mid-gut of Aeschnid, Libellulid and Agrionid larvæ, and to the imago of *Diplax striolata*.

Griffiths (Physiol. of Invert. p. 94, 1892) finds the fluids within the mid-gut (secretions of the crypts) to be always slightly alkaline; an infusion of about twenty such mid-guts readily converted starch into glucose and digested fibrin.

The hind-gut (rectum) extends from the seventh abdominal segment to the anus. No valve exists between mid- and hind-gut, but the anterior extremity of the latter is marked by the attachment of the Malpighian tubules, which may be regarded as appendages of the hind-gut. The walls of this part are also thicker than those of the fore-gut. A constriction divides the hind-gut into two parts, the anterior part being of larger calibre, and having on its inner surface longitudinal ridges, representing the branchial ridges of the nymph. These ridges fade away in the posterior part of the hind-gut.

The Odonata are rapacious and carnivorous, both as nymphs and as imagos, the former feeding on young fish, tadpoles, aquatic insects and probably many other water-dwelling animals. The food of the imagos consists mainly of insects of all orders, including their own, but especially of soft-bodied Diptera and Hemiptera. Dr. Abbott found dragonflies feeding on the decomposing remains of a calf in New Jersey, in October ("Upland and Meadow," p. 316). The cannibalistic habits of the Odonata are shown by the following facts:

it has frequently been remarked by those who have reared them in captivity, that the nymphs devour nymphs of their own and of other species. Stefanelli observed the nymphs of the European *Aeschna cyanea* to come out of the water at night and attack and devour the newly-transformed imagos of the same species. Miss Wadsworth has seen an imago of *Dromogomphus spinosus* devouring an imago of *Calopteryx maculata*, and Kuthy records *Brachytron pratense* preying on *Somatochlora flavomaculata*.

The **excretory organs** are appendages of the alimentary canal. They are known as the *Malpighian tubules*, and, as already mentioned, are attached to the point of junction of mid- and hind-gut. Their number is from 50 to 70. The fullest account of them is by Griffiths (8) for the European *Platetrum depressum*. In this species they are 60 to 70 in number and unbranched; each consists, from without inwards, of "a connective tissue layer, a delicate tracheal tube, a basement membrane, and lastly an epithelial layer of comparatively large nucleated cells." The cavity of the tubule is very irregular. The secretion of the tubules yielded uric acid, and no other ingredient was detected.

### THE CIRCULATORY APPARATUS.

The circulatory apparatus, so far as it has been recognized in the Odonata, consists of a dorsal vessel of extreme tenuity, lying in the abdomen above the alimentary canal and extending into the thorax. Blanchard states that its openings are hardly visible and not marked by constrictions; he counted seven pairs in *Gomphus* (Ann. Sci. Nat. 1848, Zool. ix, p. 389). In the hind part of the dorsal vessel of some Odonata are unstriated muscle fibres which are described by Vosseler.* A ventral abdominal pulsating sinus is also recognized by Graber.

In close connection with the dorsal vessel and with the abdominal tracheæ, are masses of yellow *fat*, to which Graber assigned the functions of absorption and the conveyance of nutrition to the various organs ("Die Insekten," vol. I).

### THE RESPIRATORY APPARATUS.

The respiratory apparatus consists of three pairs of main longitudinal tracheæ with their branches. The three pairs are found as such only in the abdomen, where, from their position, they are termed ventral, visceral and dorsal.

* Untersuchungen über glatte und unvollkommen quergestreifte Muskeln der Arthropoden. Tubingen, 1891. Pp. 94-95.

The *ventral* pair lie, one just beyond either lateral margin of the abdominal sterna. Each ventral trunk receives a branch from each of the eight abdominal spiracles of its own side of the body. The spiracles, as already mentioned in describing the abdominal skeleton, lie in the anterior part of the pleural membrane which connects the terga and sterna of the first eight abdominal segments. Each spiracle is elongated in the direction of the long axis of the body, and in the Aeschnidæ and Libellulidæ, at least, is guarded by a chitinous flap, a prolongation of one side of the margin of the opening; the free edge of this flap and the margin opposed to it are bristly. In the Agrionidæ this flap is apparently absent. Each ventral trunk supplies tracheal branches to the ventral nerve cord, the sternal abdominal muscles and the reproductive organs. In the posterior part of the thorax, each ventral trunk, which is there quite small, becomes connected with a branch of the dorsal trunk; in its course through the abdomen, a number of cross-tracheæ connect it with the dorsal trunk; at about the level of the seventh pair of abdominal ganglia, it becomes connected with the visceral and the dorsal trunk of the same side by means of a large cross branch (*Libellula pulchella*).

Each *visceral* trunk is attached to its respective side of the alimentary canal from near the hind end of the mid-gut to the base of the abdomen (*L. pulchella*), where it appears to be connected with branches of the dorsal trunks. Each visceral trunk supplies numerous branches to the mid-gut; as just mentioned it unites posteriorly with the ventral trunk of the same side and from the point of union, small tracheæ proceed to the Malpighian tubules and hind-gut.

The *dorsal* trunks are the largest of the three pairs; in the abdomen they lie above the alimentary canal, one on either side of the median line, with the dorsal (blood) vessel between them. In the thorax, however, they become ventral (*L. pulchella*) and pass into the head, supplying by their numerous branches, the organs in both head and thorax and having two pairs of external orifices—the thoracic spiracles; beyond the middle of the abdomen each trunk bifurcates (*L. pulchella*), but the two branches continue backwards side by side to the cross-trunk by which communication is had with the united visceral and ventral trunks, after which they again separate and supply the region of the hind-gut; the tergal abdominal muscles are mainly supplied by the dorsal trunks. In the second abdominal segment each dorsal trunk has connected with it, by means of tracheal stalks, two or more air-sacs. Ventral and dorsal trunk of each side are connected by cross-tracheæ.

The *thoracic spiracles* are considerably larger than the abdominal. Of the two pairs, the more anterior are the *mesostigmata*, which are situated, one in the fore part of each mesepisternum. Each mesostigma (see Pl. II, fig. 13) is a narrow, transversely elongated opening and from its position is often partly concealed by the hind lobe of the prothorax. Within its lips is a chitinous, comb-like piece, first described by Landois (Zeit. Wiss. Zool. xvii, p. 167, 1866) as a sound-producing organ. The number of teeth of the comb varies for different species and their length is not the same in different parts of the comb. Between the larger teeth is a folded membrane consisting of a single layer of rather larger cells. The second pair of thoracic spiracles are the *metastigmata*. Each metastigma lies on the side of the thorax in the lower part of the metepisternum; it is shorter, but wider than the mesostigma, is without a chitinous comb, but is guarded by a chitinous flap whose surface is spinous; probably the comb of the mesostigma is merely a modification of such a flap.

There are thus ten pairs of spiracles altogether, all functional.

Both Landois *l. c.* and Kraneher (Zeit. Wiss. Zool. xxxv, pp. 551–3) regard the thoracic spiracles as belonging to pro- and mesothorax respectively; the latter describes the metastigma and the abdominal spiracles in detail. There is apparently no reason for thinking that the mesostigmatic comb does produce sound.

The preceding account of the distribution of the tracheæ is based on personal dissection of *Libellula pulchella*. The writer is not aware that information exists as to the variations which may occur between the imagos of different groups. The account given above should be compared with the summary of the results of various students who have treated of the tracheæ of the nymphs (see *post*). The writer is not acquainted with the contents of Dr. Palmen's "Morphologie des Tracheen-Systems," a work which he has not seen.

The respiratory movements (Barlow 10, Plateau 11) consist in an alternate expansion (inspiration) and contraction (expiration) of the abdomen. The expansion or contraction is simultaneous in all the segments, the length of the abdomen is not altered. The rate of movement* varies greatly at different times owing to unknown causes, but is always quickened by exercise, increased temperature, galvanism and mechanical irritation; the last three agents quicken the movements in the decapitated insect as well. To adopt the con-

* In an entire *Libellula cyanea* held in the hand, the inspirations were 73 per minute; similarly in a *Plathemis trimaculata*, 105–118 per minute. Another individual of this latter species immediately after alighting upon a fence-rail, inspired 70 times per minute.

venient form used by Plateau, the abdominal movements may be tabulated as follows:

| INSPIRATION. | EXPIRATION. |
|---|---|
| Slower, with decreasing activity; an inspiratory pause. | Rapid and short. |
| Sterna lowered. | Sterna elevated. |
| Ventral parts of terga move outwards. | Ventral parts of terga move inwards. |
| Dorsal carina lowered. | Dorsal carina elevated. |
| Abdomen descends. | Abdomen slightly raised. |

The expiratory movements are accomplished by the abdominal muscles, especially the vertical expiratory. The inspirations are effected by the relaxation of the muscles.

Each pair of abdominal ganglia acts as a respiratory centre for its own segment, independently of the others. Decapitation does not stop the respiratory movements, but diminishes their number and amplitude; in one instance they continued for forty-three hours after removal of the head.

## THE NERVOUS SYSTEM.

The central nervous system consists of twelve distinct ganglionic masses, of which two are in the head, the supra- and the subœsophageal; three are thoracic and seven are abdominal.

The *supra-œsophageal* ganglionic mass consists of the medianly situated *brain*, or cerebrum, connected with which on either side is a very large optic ganglion. The brain lies between the upper half of the posterior foramen and the partition formed by the chitinous rods (*b*) as described for the endoskeleton of the head. Its surface is not lobed, but as it supplies nerves to the eyes, ocelli, antennæ, frons and labrum, it is to be regarded as compound in its origin, like that of other insects. Blanchard (12) shows the cerebrum of *Gomphus forcipatus* (= *vulgatissimus*) to give off one pair of optic nerves, one pair of antennal, one labral pair, one pair uniting in a frontal ganglion and one pair of small posterior tracheal.

The *optic* ganglia, large in all the Odonata, are especially so in the Aeschninæ and Libellulidæ, in correlation with the proportionately large area of the eyes in these groups. Each ganglion is connected with the brain by a distinct stalk—the optic nerve. The histological structure of the optic ganglia has been studied by Berger (14) and Viallanes (16); their results agree, and the latter summarises them as follows:

"From each elementary eye [of the compound eye] proceeds a nerve fibre (post-retinal fibre). All the post-retinal fibres are directed inwards, and traverse in their passage a sort of interposed nervous screen, which I will describe under the name of ganglionic plate. After having traversed this latter, the fibres continuing inwards, interlace completely, and so form the external chiasm. The fibres of the external chiasm then sink into a mass of granular substance known under the name of external medullary mass. They reappear to interlace again and form a second chiasm, the internal chiasm, and to acquire a second mass of granular substance, the internal medullary mass. The nerve fibres, after having traversed this mass reappear to form the optic nerve and proceed directly to the brain. We will add that to each of the masses of granular substance are annexed masses of ganglionic cells, from which they receive prolongations."

The circumœsophageal nerve-ring closely surrounds the alimentary canal, so that the interval between supra- and subœsophageal ganglia is a short one.

The *subœsophageal* pair of ganglia lie immediately below and behind the œsophagus as it turns downwards to the mouth. It supplies a pair of nerves each to the mandibles, maxillæ and labium.

The three *thoracic ganglia* are pro-, meso- and metathoracic respectively. The prothoracic pair innervates the first pair of legs, the mesothoracic the second legs and the front wings, the metathoracic the third legs and the hind wings.

The relative size of these three pairs varies. Thus in *Epiæschna heros* the prothoracic ganglia were found to be the smallest of the three, while in *Libellula auripennis* they were fully as large as the other two. In *Calopteryx maculata*, *Aeschna constricta* and *Epiæschna heros* the meso- and metathoracic ganglia are distinct from each other, while in *Libellula auripennis*, *L. pulchella* and in *Gomphus vulgatissimus* (according to Blanchard's figure), they are united. This union suggests a correlation with the obliteration of a considerable portion of the meso-metathoracic, or first lateral, suture, but as the same obliteration is also found in the Aeschninæ, the union of the ganglia in the Gomphinæ and Libellulinæ has probably followed the appearance of the suture—if the correlation really exist throughout these two groups.

The distribution of the *abdominal ganglia* is, as far as known, the same for all groups. The first pair lies in segment 1, the second in 3, the third in 4, the fourth in 5, the fifth in 6, the sixth in 7, the seventh in 8. The abdominal ganglia are smaller than the thoracic, and are proportionately larger in *Calopteryx* than in *Aeschna*. Each

pair supplies the muscles of its own segment; segment 2 is supplied by branches from the first pair of ganglia, segments 9 and 10 and the terminal appendages by the seventh pair. The experiments of Barlow (10) Plateau (11) and others have shown that each pair of abdominal ganglia is a respiratory centre for its own segment. The high degree of independence of the rest of the nervous system possessed by the different parts is shown by the experiments of Stephens (Ent. Mag. I, p. 518, 1833), who induced an *Aeschna* to devour its own terminal four abdominal segments, and which then "fled away as briskly as ever;" by similar experiments of the writer on *Pachydiplax longipennis;* and by the continuance of respiration after decapitation, or in portions of the abdomen consisting of three or four segments which have been removed from the rest of the body, as noted by Barlow.

The termination of the motor nerves in the nymph of *Libellula* has been investigated by Gabbi, who finds that the sheath of the nerve enters into close relations with the primitive muscle-bundle and is continued into the sarcolemma which forms the so-called elevation of Doyère. The axis cylinder penetrates the apex of the elevation of Doyère and divides into two branches at the base of the cone. The motor termination is situated below the sarcolemma (Bull. Soc. Ent. Ital. XVIII, pp. 310–333, 1886).

*Special Sense Organs.*—The external features of the compound eyes have been already referred to (p. 155), where the difference in size between the facets of the upper and lower surfaces in the eyes of the Libellulidæ and Aeschninæ was mentioned. Exner finds that the separate facet-members of the upper surface are absolutely, but not relatively longer, and possess no black pigment; the reverse is the case in those of the lower parts, and the transition between the two kinds in these respects is quite abrupt.* When the eyes of the living insect are examined, a number of black spots are seen, which change their location as the eye is looked at from various points of view; these are the "pseudopupillæ." Exner believes that the upper part of the eye is for "the perception of movements, the lower for the perception of form of resting objects," a conclusion for which he finds support in the fact that the pseudopupillæ of the upper surface move more rapidly, when the insect is turned in the hand, than do those of the lower surface (Die Physiologie der facettirten Augen von Krebsen und Insecten. Leipzig u. Wien, 1891). On the other hand, Plateau considers that the Odonata do not perceive form, but merely motion (Bull. Ac. Belg. (3), XVI, pp. 417–425, 1888).

Lespes describes (Ann. Sci. Nat. (4), IX, p. 240, 1858) certain structures on the antennæ which he regarded as auditory; in *Agrion*, on the third antennal joint, he found an opening closed by a white membrane, and on the fifth four tympanules placed in line, one above the other; in *Libellula* (*Diplax*) *vulgata* was nothing

* Additional details on the histological structure of the eyes are given by Lowne, Trans. Linn. Soc. (2) II. pp. 389–420, and Hickson, Quart. Journ. Micr. Sci (n. s.) XXV, pp. 222–223, etc.

similar to the first opening described for *Agrion*, but the third joint bore four tympanules; the profile of the tympanules was convex, and otoliths within very evident.

Packard has described as organs of taste the setæ and "taste-cups" situated on the inner surface of the labrum (Psyche, V, p. 223, 1889).

The sympathetic nerves of *Libellula depressa* have been described and figured by Brandt (13). From either side of the brain, near and in front of the origin of the antennal nerve, a nerve runs forwards and unites with its fellow of the opposite side in the frontal ganglion, from which a pair of small nerves is given off to the labrum; posteriorly the frontal ganglion gives off an unpaired nerve to the œsophagus. Lying on the dorsal surface of the œsophagus, immediately behind the brain are two pairs of small ganglia, of which the anterior pair is on the middle line and in contact, while the posterior pair is separated, each ganglion lying on the lateral margin so to speak of the œsophagus; anterior and posterior pairs are connected; nerves are supplied to the œsophageal walls. Apparently it is the posterior pair which corresponds to the pair of tracheal ganglia of Blanchard.

We know but little as to the intelligence of the Odonata. Fennel records (Mag. Nat. Hist. VI, pp. 271–272, 1833) an observation of interest on this topic. A male and a female of a species of *Aeschna* were flying and sporting over a pond, when another male appeared and chased the female. The first male turned upon the newcomer, and a struggle ensued between the two males until one fell into the water; the other alighted upon him as he floated on the water's surface, remained there for a short time and then joined the female, who had continued to fly around the pond without manifesting any interest in the combat. An examination showed that the conquered male had been deprived of his wings by the victor, and so was unable to rise. A natural interest as to whether the victor was the original possessor or the newcomer, is not gratified by the narrative.

## THE REPRODUCTIVE ORGANS.

The Odonata are in all cases unisexual. The **male** reproductive organs—*testes* are paired, one lying on either side of the abdomen above the alimentary canal. Each testis is an elongated, cylindrical organ, held in place by tracheæ; when fully developed, its anterior extremity lies in the fourth segment. At its hind end each narrows somewhat to form the vas deferens, which passes below the hind-gut in the seventh or eighth segment and only unites with its fellow of the opposite side at the common opening on the ventral surface of 9. The two vasa deferentia are without permanent dilatations or seminal vesicles. The opening of the common duct, as already mentioned, is guarded by a chitinous flap on either side.

The *spermatozoa* of the Agrionidæ and the Aeschnidæ are very slender, very agile and of hair-like form, while those of the Libellulidæ are thicker and immobile (Siebold 17). Several stages in the development of those of *Agrion puella* and *Calopteryx virgo* are described and figured by Butschli (Zeit. Wiss. Zool. XXI, pp. 528, 529, pl. xl, 1871).

The *external genital organs* of the male are separated from the orifice of the duct of the testes and lie in a pocket on the ventral side of the second abdominal segment, entirely outside the body cavity and having no communication with it. They consist of a *penis* and its *vesicle*, lying in the median line, and on either side of these one (Libellulidæ) or two (Aeschnidæ, Agrionidæ) pairs of processes—*genital hamules* (see Pl. II, figs. 3–6). The vesicle of the penis is a sack with chitinous walls, lying at the hind end of the pocket and firmly attached at its basal end to the anterior portion of the sternum of 3. Its distal extremity may (Anisoptera) or may not (Zygoptera) be attached to the penis. In the former case the penis is a three-jointed, chitinous tube, bent ventrally on itself and then directed backwards, with its cavity (lumen) continuous with that of the vesicle; a longitudinal opening to the exterior is present on the convex side of the second joint, and the apical, or third joint terminates variously in different species. In the latter case the penis is unjointed, and is attached to the floor of the pocket (*i. e.* to the sternum of 2). In either case the penis is situated immediately in front of the vesicle. The hamules are variously shaped; the anterior pair is the larger in the Agrionidæ and the Aeschninæ, the smaller in the Gomphinæ; the single pair present in the Libellulidæ corresponds to the posterior pair (Hagen, 39, pp. 273–74). In front of the anterior pair, the anterior sternal border of 2 forms a variously-shaped, downwardly-projecting piece—the *anterior lamina* —which forms the front boundary of this genital pocket. Between the hamules, and immediately in front of the penis, there is in the Aeschnidæ, and to a less extent in the Agrionidæ, a median, hood-like, chitinous piece, under whose arch the penis is folded when not in use. This is the *sheath of the penis.** In the Libellulidæ this is

* It is here to be remarked that de Selys and Hagen (40, 43, and in their Revue des Odonates d'Europe) have applied the term "sheath of the penis" (gaine du pénis), not as by Rambur (33) and as above, but to the vesicle of the penis, while the real sheath of the penis is called the *cuillere*. Rambur's description is very clear, and his terms are followed in the text. Hagen uses the term "vesicle of the penis" in (36).

absent, but a posterior, backwardly and downwardly-directed process (*genital lobe*) arises from either side of 2, and between those of the right and left sides, the vesicle of the penis lies. The hamules are apparently for clasping the edges of the vulvar lamina during copulation. The sheath of the penis and the genital lobes are protective organs.

The separation of the orifice of the duct of the testes and the intromittent organ in the Odonata is not a unique occurrence in the animal kingdom. In male spiders the common duct of the testes opens on the base of the abdomen, while a pedipalp is modified to form the copulatory organ. So, also, among the Cephalopods, one of the arms of the male is modified (hectocotylized arm) for the purpose of introducing the spermatophores within the mantle of the female.

The reproductive organs of the **female,** the *ovaries*, are also paired and occupy the same relative position as the testes; when functionally active, they extend forwards even as far as into the hind part of the thorax. The ovarian tubes are very numerous and open into an oviduct which unites with its fellow of the other side, in the eighth segment, to form the vagina. The vagina is provided with a dorsal pouch—*bursa copulatrix*—and one or two *receptacula seminis*. In *Calopteryx*, the receptaculum consists of two small lobes which unite in a common canal; in *Agrion* there is a single lobe; in the Anisoptera there are two receptacula, each with a distinct canal (Siebold 17). The external orifice of the vagina (vulva) is at the ventral apex of 8. It may be simply an uncovered opening, or the posterior extremity of the sternum of 8 may be prolonged as the *vulvar lamina* to assist in oviposition.

In the Agrionidæ, the Aeschninæ, the Cordulegastrinæ, and some Gomphinæ, the vulvar lamina is prolonged into two trough-like plates, pointed at their distal extremities, with their concave faces opposite each other so as to form a tube-ovipositor. Each plate consists of two curved styles united side by side; on the outside near the apex are some transverse ridges forming a file-like surface (Agrionidæ, Aeschninæ). In the Agrionidæ, Aeschninæ, and certain Gomphinæ (*Petalura*), there lies on either side of this ovipositor a chitinous piece—*genital valve*, derived from the sternum of 9. Articulated to the apex of each genital valve is a slender, unjointed process (*valvular process*) which terminates, in the Aeschninæ and the Gomphinæ of the legion *Petalura*, with a small bundle of hairs; in the Agrionidæ these hairs are absent. The function of the genital valves is probably to assist in the placing of the eggs within incisions (made by the pointed and roughened ends of the ovipositor) in the

tissues of water plants, and also to steady the abdomen during oviposition. In the remaining Gomphinæ and in the Libellulidæ, the vulvar lamina, although often large and variously shaped, does not serve for the insertion of eggs within plants, and there are no genital valves.

The *ova* (unfertilized) are elongated, and as they lie with their long axes parallel to the long axis of the ovarian tubes, their two extremities may be definitely distinguished as anterior and posterior poles. The anterior pole is that which is towards the head of the mother; it corresponds to the head end of the embryo in late, though not in early, embryonic life. The other pole is the posterior, is directed towards the tail end of the mother and corresponds to the tail end of late embryonic life. The micropyle is situated at the anterior pole.

*Secondary sexual differences* are of size, of structure and of color. In some groups the males, in others the females are larger, as may be seen from the dimensions given for the species in Part II. Structural differences are found in differences of venation of the post-costal space in some Calopteryginæ (*Hetærina*); in the shape of the prothorax and of the tenth abdominal segment in many Agrioninæ; in the shape of the occiput, the relative development of the femoral spines, and the possession of spines on the vertex by the female, in many Gomphinæ; in the replacement of the tibial spines by knobs in the males, but not in the females of *Cordulegaster;* in the possession of auricles and an excavated anal border of the hind wings by the males of Cordulinæ and many Aeschnidæ. When the colors of male and female are different, those of the male are usually brighter. The pattern of coloring both of abdomen and of wings may be quite different in the two sexes; in such cases, that of the teneral male is more like that of the adult female than is that of the adult male. From various considerations Walsh concluded that in many [*e. g.* the Calopterygine *Lais* and *Hetærina* and some *Gomphus*] though by no means in all Odonatous groups there is a great overplus of males (Proc. Ent. Soc. Phila. ii, p. 223).

*Dimorphic females* exist in the Libelluline genus *Neurothemis*, where the heteromorphus female has a more open venation than the male and the isomorphous female (Brauer), and in the Agrionine genera *Ceratura*, *Anomalagrion*, *Ischnura* (see Part II) and *Agriocnemis*, where the coloring of the heteromorphous female is quite different from that of the male and normal female (Selys).

Hagen has recorded instances of the copulation of different species, but nothing is known of their progeny (Ent. Weekly Intel. 1857, pp. 62, 63. Stet. Ent. Zeit. xix, p. 44, 414-15, 1858).

## OVIPOSITION.

Owing to the separation of the intromittent organ from the external opening of the vas deferens in the male, an essential prelude to the act of copulation is the filling of the vesicle of the penis with sperm. This is accomplished by the curving of the abdomen ventrally upon itself so that the ventral surfaces of the ninth and second segments come in contact. While no precise details have been recorded, it seems probable that in the Zygoptera the sperm passes directly from the vas deferens through a fissure on the free end of the vesicle to its interior, and the penis is filled by applying it to the vesicle. In the Anisoptera the sperm passes through the penis into the vesicle. This preliminary stage ended,* the male flies after a female, seizes her by his feet, and then clasps her prothorax with his abdominal appendages. She then curves the apex of her abdomen ventrally forwards and upwards, so that the vulva shall come in contact with his accessory genital organs, and the sperm is introduced into the vulva by the penis. During copulation, therefore, the male is above and in front of the female; the heads of both are turned in the same direction. While in most of the groups the act of copulation lasts but for a very short time and takes place while flying, it would appear that among the Agrioninæ a considerable period elapses between the clasping of the female's prothorax and the curving of her abdomen to meet that of the male, and that the impregnation is effected when at rest. The spermatozoa upon being received into the vagina pass into the receptacula seminis and the bursa copulatrix, and the eggs are fertilized as they pass the openings of these pouches on their way down the vagina.

Oviposition, as a general rule, immediately follows copulation. In the Agrionidæ,† the Aeschninæ, and probably in the Petaluroid Gomphinæ and the Cordulegasterinæ, the eggs are laid within the tissues of plants below the water's surface in conformity with the

* Todd records the male of *Lestes* as charging the seminal vesicle *after* the female had been seized (Amer. Nat. xix, pp. 306-7).

† Apparently the only observation which conflicts with this statement is that of Walsh (Proc. Ent. Soc. Phila. ii, p. 322), who "observed that *Hetærina* ♀ flirts her eggs into the open river, without attaching them to aquatic plants." This assertion should be tested by further observations.

structure of the vulvar lamina as an ovipositor; this may be termed *endophytic* oviposition. In the other subfamilies no ovipositor exists, and the eggs are merely dropped into water or attached by a gummy substance to the surfaces of submerged bodies; such oviposition may be styled *exophytic*. In either of these cases the male may or may not retain his hold of the female's prothorax by his appendages during oviposition.

1. *Endophytic oviposition.*—A favorable opportunity enabled the writer to see, in *Argia violacea*, an Agrionine, the sharply pointed and roughened ends of the halves of the vulvar lamina cut into plant tissue and push the eggs into the incisions. The valves assist in the deposition and probably also steady the abdomen. The first eggs in this case were laid just below the water's surface, the female gradually descending and inserting the eggs farther and farther downwards. The laying of the eggs in plants below the surface, necessitates the descent of the female into the water, so that she may be completely submerged, as the writer has witnessed in *Enallagma exsulans*, and as has been observed in different species of Agrioninæ and Aeschninæ by many others. When the male retains his grasp of the female's prothorax during oviposition, and the female continues to descend, he usually loosens his hold and separates from the female to avoid being dragged into the water. Von Siebold saw the male of *Lestes sponsa* also descend below the surface with the female, and the writer has witnessed the same phenomenon in three different pairs of *Enallagma exsulans*. When immersed, both male and female are encased by an envelope of air. After eggs have been deposited in a plant, by holding the latter between one's eyes and the light, the eggs can usually be seen lying between the veins of the leaf-blade. While the male and female of endophytic groups remain attached during oviposition to a greater extent than in the exophytic groups, yet *Anax junius* and *Ischnura verticalis* have been seen by the writer at one time to lay the eggs without the attachment, or even presence of a male, and at other times to lay them with the male attached.

2. *Exophytic oviposition.*—The female repeatedly dips the end of her abdomen into the water at a rate, in *Plathemis trimaculata*, of 120–150 dips per minute. At other times she strikes the water with her abdomen with such force as to fasten the eggs upon the vertical surface of rock (Buckhout). The eggs of this group are found to be covered with a transparent substance which causes them to adhere to adjacent objects. The dipping of the female's abdomen

enables the water to wash the eggs from her body. While the eggs are usually distributed in small numbers, Gerard found bunches of 30–40 egg-masses, each twelve to fifteen inches long and one-eighth of an inch in diameter, with about 500 eggs to the inch, and which subsequently yielded Libelluline larvæ (Am. Ent. iii, pp. 174–75). While the male usually releases his hold of the female immediately after copulation, *Diplax* frequently oviposits in pairs. Even when the male separates, he frequently follows the female while she is discharging the eggs.

Most individuals probably pair more than once. A second pairing may take place while a female is in the very act of oviposition, as the writer has observed in *Plathemis trimaculata* and *Libellula pulchella;* in both of these cases, after the interruption, the female resumed the discharge of the eggs.

## 2. Development of the Odonata.

### EMBRYONIC (oval) DEVELOPMENT.

The eggs of the Odonata are smooth, pale yellow, elongated in the endophytic, elliptical and wider in the exophytic forms. The period of oval development varies from six days in *Libellula pulchella* and *Ischnura verticalis*, to three weeks in *Calopteryx virgo* (Brandt). The number of eggs laid by one female is very variable; 300 was the highest found by Brandt in *C. virgo*.

Our knowledge of the embryonic development of the Odonata is based chiefly on the researches of Brandt (18) on *Calopteryx virgo*. What is here presented is mainly an abstract of his paper.

The anterior pole of the freshly-laid egg is distinctly more pointed than the posterior. An examination of the outline of the egg shows one of its long sides to be almost straight, while its opposite side is distinctly convex; the straight side corresponds to the *ventral* surface of late, but not early, embryonic life, and the convex side to the dorsal surface of late embryonic life, and will be so designated in the following account. The length of the egg is 1 mm., its greatest breadth .2 mm. Two membranes enclose the egg, an outer (chorion) and an inner (vitelline membrane). The chorion is structureless and at first colorless; it is thickened at the anterior pole, and here also a small gelatinous mass adheres. The micropyle passes excentrically through the summit of this thickening of the chorion. Moreover, a delicate, folded, funnel-like membrane is

placed just beyond the gelatinous mass. Both membrane and mass increase the facility of entrance of the spermatozoa into the egg. Within the very thin vitelline membrane are mostly yolk spheres and fat drops with, of course, the egg-nucleus.

The blastoderm does not apparently arise as a continuous layer, but in isolated patches, which afterwards unite and form a single layer of cells over the entire surface of the egg, but within the egg membranes. Six to twelve hours from the time of oviposition were required for its complete formation. The blastoderm then thickens slightly at both poles and also on the ventral surface near the posterior pole. This latter thickening (the *ventral plate—Bauchplatte—bp*, fig. 33A) is shield-shaped and consists of two or more layers of

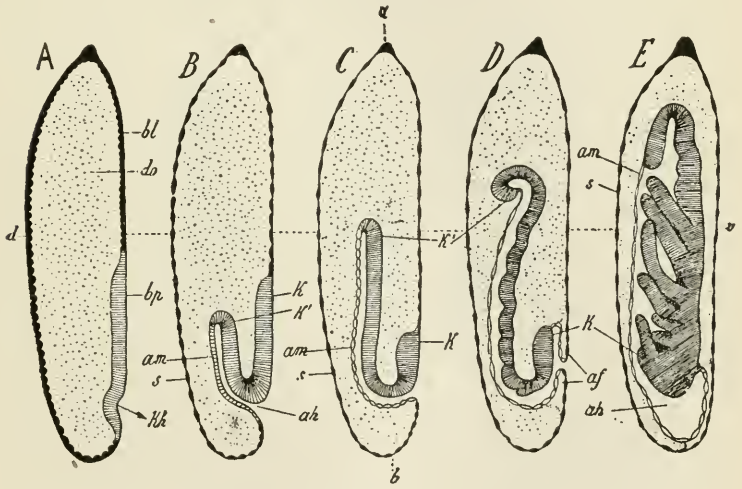



**Fig. 33.**

Five diagrammatic median longitudinal sections of the egg of *Calopteryx* (after Korschelt and Heider, based on Brandt).

A—E, successive stages in development. The egg-membranes are omitted.

*a*, anterior pole of egg.
*af*, amnion fold.
*ah*, amnion cavity.
*am*, amnion.
*b*, posterior pole of egg.
*bl*, blastoderm.
*bp*, ventral plate.
*d*, dorsal side of egg.
*do*, yolk.
*k*, head end of the germinal band.
*k'*, tail end of the germinal band.
*kk*, beginning of the invagination.
*s*, serosa.
*v*, ventral side of egg.

cells, but fades, without distinct boundaries, into the rest of the blastoderm. An invagination now takes place in the ventral plate in the form of a tube-like insinking into the central part of the egg

(fig. 33B). The cavity of this tube is the *amnion cavity;* its inner blind end is directed towards the anterior pole of the egg, which it approaches more and more as the tube increases in length. The blind end is what will hereafter be the tail end of the embryo, and at this stage of development, is much nearer the anterior than the posterior pole. The walls of this tube are, from their mode of origin, continuous with the uninvaginated parts of the ventral plate; as the tube increases in length, that part of its walls nearest the dorsal surface of the egg steadily diminishes in thickness until it forms a mere

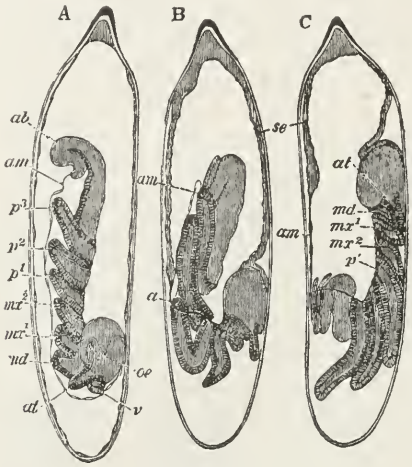



**Fig. 34.**

Three later stages of the embryonic development of *Calopteryx*, showing the turning of the embryo within the shell (after Korschelt and Heider, based on Brandt). The egg-membranes are shown here.

*a*, opening of the amnion cavity through which the embryo passes.
*ab*, hind part of the abdomen.
*am*, amnion.
*at*, antenna.
*md*, mandible.
*mx*¹, first maxilla.
*mx*² second maxilla (half of labium).
*oe*, beginning of œsophagus.
$p^1$, $p^2$, $p_3$, first, second and third leg.
*se*, serosa.
*v*, front head.

membrane—the *amnion;* that part of the wall nearest the ventral surface of the egg is not thinned, and gives rise eventually to the entire ventral surface of the embryo and the paired appendages, including those of the head (fig. 33C).

Meanwhile, the uninvaginated portions of the ventral plate are gradually reduced to a sharply circumscribed area in front of the mouth of the amnion cavity, and become divided into two bilaterally

symmetrical halves—the *lateral lobes* (*Seitenlappen*), which eventually take part in the formation of the head. The thick part of the wall of the invaginated tube, together with the lateral lobes, forms the *germinal-band* (Keimstreif).

While the above-described changes have been taking place in the germinal band, the cells of the rest of the blastoderm, except at the anterior pole, have become flattened and surrounded by an intercellular substance. The most external layer of cells of the lateral lobes undergoes the same change, unites with the similar cells around the mouth of the invagination, and so closes the open end of the amnion cavity. The egg is thus enveloped by a membrane—the *serosa*—which is entirely free and unconnected with the amnion,* or the germinal band. Meanwhile the yolk, which lies almost everywhere between the serosa and the embryo, has been divided into spheres.

The deep (hind) end of the germinal band now curves so that the hind part of the abdomen becomes folded ventrally upon itself. Three pairs of swellings appear on the amniotic side of the germinal band, the beginnings of the three pairs of legs. In front of these (in this stage of development, nearer the posterior pole of the egg) three similar pairs of swellings soon appear, which will be the two pairs of maxillæ and the mandibles (fig. 33D). The length of these swellings decreases from behind forwards. As soon as these swellings are clearly recognizable, two distinct layers can be seen to be forming in each—an outer, skin layer and an inner, nerve-muscle layer; each layer of each swelling is continuous with the similar layer of the swelling in front and behind. As they increase in length, the swellings are directed towards the hind end of the embryo. Soon after the formation of the mandibular swellings, a similar antennal pair appear in front of them, and in front of the antennæ a single, median, unpaired swelling, the *front-head* (Vorderkopf). Antennæ and front-head show the same two layers as the other extremities. Behind the front head an invagination takes place—the beginning of the fore-gut. The front-head eventually gives rise to the clypeus and the labrum, and fuses with the lateral lobes which form the remainder of the head, excepting, of course, the mouth-parts.

The embryo now stretches itself so that the lateral lobes, instead of lying near the ventral surface of the egg, approach its posterior

* The amnion is the *viscerales Blatt* of Brandt, and the serosa is his *parietales Blatt.*

pole. Up to this period the embryo has occupied a reverse position to that in which it is found in later embryonic life. Its head end has been much nearer the posterior than the anterior egg pole, and its hind end nearer the anterior pole, while the appendages have been directed towards the dorsal egg surface (fig. 33E). The manner in which it changes its position will now be described.

Near the point where the amnion cavity was closed by the growth of the serosa, the amnion and serosa fuse together. The fused part tears. The torn right and left halves adhere to the dorsal egg surface. By contractions of the serosa, the yolk substance is drawn towards the anterior egg-pole, and this in turn forces the embryo, head first, through the rent. When this turning out is completed, the embryo lies with its head near the anterior pole, the appendages towards the ventral egg-surface, and the hind end of the abdomen, which is still folded ventrally on itself, towards the posterior pole. The ventral egg-surface, which was at first almost straight, is now also convex, owing to the increase in size of the egg-contents. The mandibles and first maxillæ lie transversely, the other appendages are directed backwards and somewhat towards the median line. The hind end of the abdomen bears three pieces, the beginnings of the tracheal gills, which conceal between them an invagination, which is the commencement of the hind-gut (fig. 34).

Brandt has given no detailed account of the remaining phenomena of embryonic development. He merely mentions that the segmentation of the body becomes more distinct, the appendages become jointed, teeth appear on the mandibles, the second maxillæ unite along their inner edges, the eyes appear, the cuticle becomes light brown, the yolk gradually disappears from the outside of the germinal band, its remainder being visible in the mid-gut.

When the embryo has reached its final position in the egg, the germinal band forms merely the ventral surface, the appendages and the greater part of the head of the embryo. The dorsal and much of the lateral parts of the thorax and abdomen are represented solely by amnion and serosa enclosing the remaining yolk in a sack. It is considered probable by Korschelt and Heider (18, p. 803), that the serosa part of this sack thickens, is invaginated into the yolk filling the sack, becomes constricted off, that its cells break up and mingle with the yolk, and that the walls of the yolk-sac are then furnished by the amnion alone. Whether the amnion is converted into the definite dorsal body-wall, or whether this is formed by lateral up-

growths of the germinal band is unknown. No account exists of the formation of the endoderm and mesoderm, or of the internal organs.

## THE NYMPH.

The term *nymph* is here used to denote that stage of Odonate existence between the egg and the transformation into the imago. The length of time which elapses between the hatching of the egg and imagination (nymphal period), and the number of moults during that period, have not apparently been recorded for any species. It seems probable that the time extends over a considerable number of months, at least in the larger species, and that moulting occurs many times.

The nymph of *Anax junius*, just hatched, is 2 mm. long; the length of the nymph skin remaining after imagination is 45 mm. A nymph of this species obtained in August, 1888, moulted September 3d, the cast-off skin being 15 mm. long; it moulted again September 20th, the length of the exuvia was about 17.5 mm.; this nymph died before moulting again. According to Poletaiew (5), the rudimentary wing-covers only appear in Odonate nymphs after the third or fourth moult; both of these last mentioned exuviæ show these covers. These facts appear to support the statement just made, although, of course, captivity may have retarded the rate of growth.

The **young nymph**, when hatched, is about 1 mm. long in *Libellula pulchella*, 2 mm. in *Anax junius*. In all the groups it is flattened from above downwards, the head is large and distinct, the three thoracic segments are clearly visible, and likewise the ten abdominal segments. The eyes are relatively small, and in all the groups are widely separated from each other. The antennæ, on the contrary, are much longer than in the imago, being as long as the head in the young nymph of *Mesothemis simplicicollis;* they consist of three joints, of which the terminal one is much the longest, except in the legion *Calopteryx*. No ocelli are visible. Both mandibles and first maxillæ are present, somewhat similar to those of the imago. The labium (second maxillæ) has the form which is so characteristic of the Odonate nymphs (see Pl. II, fig. 8), and is known as the *mask*.* It is proportionally very much longer than in the imago. It consists of a basal piece (submentum), attached to the head, and which at its distal end bears a second piece (*m* and *ml*, fig. 8), corresponding to the mentum and median lobe of the imago together. The

* So-called from the circumstance that in many genera, *e. g. Libellula*, the lateral lobes are so large as to cover (mask) a great part of the face, when folded in rest.

distal extremity of this second piece bear at either angle, a lateral joint (*ll*), the lateral labial lobe of the imago. On the outer side of the lateral lobe is one or more articulated spines, of which the apical one (*tp*) is probably the free terminal joint of the labial palp, while on the inner side are teeth or spines (figs. 8, 9, 10). The submentum is directed backwards, and, in rest, lies in contact with the ventral thoracic surface, between the bases of the legs. The articulation of the submentum with the second piece is hinge-like, the latter being directed forwards. The planes of the lateral lobes are inclined to that of the second piece. The labium can thus be protruded to a considerable distance in front of the head, while the movement of the lateral lobes is from side to side, their teeth and spines completing the already formidable armament of the mask. The feet are very long in proportion to the body, thus giving a spider-like appearance to the nymph. Their main divisions are clearly expressed, and are sparsely clothed with hairs, but the joints of the tarsus are indistinct, and the tarsal nails are not toothed. Owing to the flattened form of the body, the bases of the legs of the right and left sides are much farther apart than in the imago. The shape of the abdomen varies in the different groups. At its hind end there are in the Zygoptera, three long, sparsely hairy, caudal tracheal gills, of which one is median and dorsal, the other two lateral and more ventral. In the Anisoptera, in the same positions as those occupied by the gills, are three chitinous pieces which act as valves to guard the anal opening. Between these three pieces—which are called middle and lateral appendages by Hagen—there is also in the Anisoptera, a pair of chitinous parts, which in life are constantly moving in a horizontal plane to and from each other in the process of respiration. Their function is probably to constantly renew the water in the rectum, in which are situated the rectal tracheal-gills. No traces of external genital organs are visible. The alimentary canal is complete, but there are as yet no salivary glands. Packard (19) distinguished the dorsal vessel in recently-hatched nymphs of *Diplax*, where the "flow of blood to the head and the return currents through the lacunar or venous circulation along the sides of the body are easily observed." On either side of the body is a large longitudinal trachea (dorsal trunk?) from which branches proceed to the various parts of the body and the appendages, and are especially numerous in the rectal region. The ventral nerve cord and the cephalic ganglia are present; in the youngest nymphs of *Ischnura verticalis* and *Libellula pulchella*, the

writer finds eight distinct pairs of abdominal ganglia in segments 1 to 8; the last pair being the largest.

**The subsequent changes which take place in the nymph** up to the time of imagination, are as follows:

The relative increase in size of thorax and abdomen is much greater than that of the *head*, so that the latter, which, in the young nymph, was one-fourth or more as long as the trunk, in the last nymphal stage is only one-sixth to one-ninth of that length. The eyes soon become relatively larger, but never in any of the groups do they meet upon the top of the head. The epicranium is consequently of large size. The clypeus does not become differentiated into post- and ante-clypeus. The ocelli can be distinguished in old Agrionine nymphs at least. The long terminal antennal joint of the young nymph divides into a number of joints, in most of the subfamilies. Mandibles and first maxillæ closely approach the form of those of the imago. The labium throughout retains its large proportionate size; the shape of its lateral lobes is different in the young and old nymphs of the same species.

*Thorax.*—In the young nymph the prothorax is almost, or fully as large as either of the other two thoracic segments, but as the nymph increases in size, the meso- and metathorax become relatively larger, due to the development of the wing-covers and the wing-muscles. The wing-covers appear after the third or fourth moult (Poletaiew), as small triangular flaps, one on either side of the meso- and metanotum. They increase in size with each successive moult, are directed backwards, and lie upon the dorsal surface of the thorax and anterior abdominal segments, the hind wing-covers lying over and concealing the greater part of the front wing-covers; the courses of the chief longitudinal veins become quite apparent in the old nymphs. As the wing-covers increase in size, the right and left mesepisterna, which at first were entirely separate, extend dorsally and meet each other, first at the front margin of the mesothorax, their union extending gradually backwards towards the base of the front wing-covers. The boundaries of the pleural sclerites may be distinguished in the old nymphs. The bases of the legs remain quite far apart up to imagination; the length of the legs although great throughout nymphal life, is relatively less than in the first post-oval stage. The hairs which clothe the legs of the young nymph are soon lost; in their stead may be seen longitudinal rows of very minute spines, rudiments of those of the imago. Although the tarsi

of living Odonate imagos are universally three-jointed, and while most nymphs agree in this respect, the first and second tarsi of the nymphs of the Gomphinæ are never more than two-jointed. The oldest nymphs rarely show any trace of the tooth on the tarsal nails.

The *abdomen* is always much shorter and broader than in the imago, and owing to its flattened form, the distinction between dorsal and ventral surfaces is much more evident. The pleura are equally well chitinized as the terga and the sterna; in the Zygoptera they are infolded, in the Anisoptera exposed to view on the ventral surface; the sterna are rectangular. Along the lateral margins of the segments a spine is frequently developed, the arrangement of which is often of generic character.

The three tracheal-gills which terminate the abdomen of the Zygoptera are, in the young nymph, conical, tapering gradually to the apex, longer than the abdomen and sparsely hairy. In *Calopteryx* they become triangular in cross-section; in the Agrioninæ, each gill becomes a flat, thin plate; in both cases they enclose tracheal branches. Their relative length decreases.

In the Anisoptera, where, from the first, the places of the terminal gills are occupied by chitinous, non-respiratory appendages, the middle or dorsal appendage appears to be the shortest even at hatching. The pair of chitinous pieces, described as being constantly in motion in young Anisopterous nymphs, apparently disappears in early nymphal life. It is perhaps a fact of some significance that the hairs which are found in the youngest nymphs on the thorax, abdomen, legs, terminal gills in the Zygoptera or three terminal appendages in the Anisoptera are early lost.

The superior terminal appendages of the imago appear in the nymph at about the same time as the wing-covers, as a small conical process on either side of the dorsal gill or dorsal appendage. They increase in length with each moult, but never become as long as the gill or appendage between them. A comparison of recently transformed imagos and old nymphs indicates that the anal segment of the imago is formed by the representatives of the three caudal gills (Zygoptera) or appendages (Anisoptera) of the nymph. In the females (imagos) of both of these groups neither dorsal nor lateral pieces are greatly developed, and the anal opening lies between all three. In the males of the Zygoptera the two inferior appendages correspond in position to the two lateral gills of the nymph; the anal opening lies between them and is bounded above by a plate

corresponding to the dorsal gill. In the males of the Anisoptera the dorsal appendage of the nymph is represented by the single inferior appendage of the imago, and the two lateral appendages by the right and left halves of the tubercle in which the anus lies, below the inferior appendage. The inferior appendages of the males of the Zygoptera and Anisoptera are therefore not homologous.

The only external genital organs which appear in the nymphal period are to be found on the ventral surface of the ninth segment of older nymphs of the Agrionidæ, the Aeschninæ and the Cordulegasterinæ. The female nymphs of these groups may be recognized by the longitudinal ridges, which correspond to the form of the vulvar lamina and the genital valves of the imago. The old male nymphs of the Agrioninæ have two ventral hooks near the apex of 9, representing the two valves closing the orifice of the common duct of the testes. The same are also indicated by a slight eminence in male Aeschnine nymphs.

The information which exists as to the development of the internal organs is very little. The abdominal *muscles* form a more complete sheath than in the imago; they are well developed in the youngest nymphs. Poletaiew (5) believes the wing-muscles to be formed at the same time that the wing-covers first appear; they then are composed of globules similar to those of adipose tissue and interlaced with tracheæ, while all the other muscles are striated, as are the wing and remaining muscles of the imago. In consequence of the shape of the thorax, the wing-muscles of the nymph are more vertically placed at first, and subsequently change their direction in conformity with the increasing obliquity of the thorax.

The positions of the three parts of the *alimentary canal* correspond in older nymphs at least, to those of the imago, and the histological structure of the mid-gut is the same (Faussek 7). The characteristic features of the hind-gut will be referred to in connection with the respiratory apparatus. The time of the first appearance of the Malpighian tubules is unknown, but they are well developed in old nymphs.

The *respiratory apparatus* has been carefully studied by Oustalet (28) and Roster (30) in the nymph of the European *Aeschna cyanea* (*maculatissima*) and by Miss Olga Poletaiew (29) in those of *Ae. grandis* and *juncea*. Oustalet distinguishes three main pairs of tracheal trunks—dorsal, viseral and ventral, as already described for the imago of *Libellula pulchella*. The *dorsal* pair lie on the dorsal

surface of the alimentary canal in the head, thorax* and anterior abdomen, posteriorly they become more lateral. In the thorax they lie closely side by side, pass into the head, are connected by a cross trunk at the base of the brain, and then each bifurcates. In the middle of the thorax a cross-trachea connects the two dorsal trunks, and from this cross-trachea a branch is given off to the metastigma of each side. In the thorax each dorsal trunk gives off the following principal branches to its own side of the body: one to the mesostigma; one to the third leg; one which unites with a tracheal coming from the mesostigma, the common trachea running to the second leg; another tracheal runs from the mesostigma to the first leg, but on its way gives off a recurrent which runs forwards and underneath the œsophagus and unites with its fellow of the other side to form a loop, from which loop a branch runs forwards on either side below the œsophagus into the mask. In the abdomen each dorsal trunk is connected by six cross-tracheæ with the ventral trunk of the same side. The anterior end of each *ventral* trunk terminates in fine branches in the hind part of the thorax; between the fifth and sixth of the cross-tracheæ connecting it with the dorsal trunk the visceral trunk unites with it, the common trunk continuing backwards and finally terminating in tracheoles. Anteriorly, each *visceral* trunk empties into the branch given off by the dorsal trunk to the second leg, but of the other side of the body. In *Aeschna cyanea* the visceral trunk unites posteriorly with the ventral trunk, but remains separate in *Diplax vulgata* and *Platetrum depressum*. Roster's figure of the tracheal system of *Ae. cyanea* agrees in the main with the preceding account of Oustalet, except that he shows each ventral trunk to run forwards to the mesostigma of the same side.

The writer has been able to verify many of the details of distribution given by Oustalet, in the nymph of *Lestes forcipata*. Here the dorsal trunks are six or more times larger in calibre than the visceral or ventral trunks. In the hind part of 9, each dorsal trunk bifurcates, the more lateral branch supplies the lateral caudal tracheal-gill, the upper joins its fellow of the other side in the dorsal caudal tracheal-gill. Each visceral trunk empties anteriorly into the branch to the third leg of the other side of the body.

* Compare the account given of the dorsal trunks for the imago of *L. pulchella*, p. 179. The significance of this difference is unknown.

The chitinous lining of the rectum of the Anisopterous nymphs is modified so as to present the appearance of six longitudinal bands, *rectal tracheal-gills*. Each of these tracheal-gills consists of two rows of thin lamellæ in the Libellulidæ, of two rows of villous tufts in *Aeschna cyanea* (Oustalet), or of two rows of lamellæ, similar to, but of different shape from those of the Libellulidæ, in *Aeschna grandis* and *juncea* (Miss Poletaiew). Into each lamella, or into each papilla of each tuft, run one or more tracheals and split into tracheoles, which run to the apex of the lamella or papilla, recurve and anastomose with efferent twigs.* The lamellar or papillar tracheals are derived, according to their situation, from a dorsal or a visceral trunk. Each dorsal trunk gives off nine or ten cross-tracheæ to each of the upper two rectal tracheal-gills of its own side of the body, while the lowermost (ventral) gill is supplied by about eight cross-tracheæ from the visceral trunk of the same side (Oustalet). The epithelium of the hind-gut of an *Aeschna*-nymph has been studied by Faussek (7), who finds it to be of two kinds, sharply distinct from each other: 1, of large cells and nuclei; 2, of small cells and nuclei. No regularity in their distribution exists; the smaller cells are found in compact, involved folds, the larger where there are none or only simple, isolated folds. At the extreme hind end of the rectum are six rectal glands, from the simultaneous presence of which, with rectal gills, Faussek concludes with Chun (Abh. Senckb. Natf. Gesell. x, pp. 27–55) in opposition to Gegenbaur, that rectal glands are primitive, rectal gills secondary. The rectal tracheal gills are not carried over into the imago (Hagen 27), but as previously mentioned, their vestiges persist. The rectal chamber may serve both for aquatic and for ærial respiration, and, by violently ejecting its contained water, for propulsion, and apparently for defense (Miss Monks, Am. Nat. xv, p. 141).

The existence of three rectal-tracheal gills in *Calopteryx*, announced by Dufour (Compte Rendu, l'Acad. Sci. T. 29, pp. 764–7, 1849), though denied by Miss Poletaiew (29), has been reaffirmed

* Such is the account given by Oustalet. Macloskie states that the ultimate tracheal ramifications in these lamellæ end cæcally, and that the "action of the tracheæ is tidal rather than by peripheral capillary circulation" (Psyche iv, pp. 111, 112, 1883). The results of the writer's examination of the lamellæ of a Libellulid nymph and of the caudal tracheal-gills of *Lestes* agree with those of Oustalet. As, however, the recurrent tracheoles become connected with the twigs from which the efferent tracheoles arise, the peripheral capillary circulation, if there be such, must be confined to the loops alone.

by Hagen (27). Dufour (*l. c.*) regarded the caudal tracheal-gills of *Calopteryx* merely as "swimmerets or oars," and although they do serve this purpose, yet the middle tracheal-gill is well supplied with tracheals and apparently functions as a respiratory organ. The nymphs of the Calopterygine genus *Euphœa* are remarkable in that they possess three *functional* caudal tracheal-gills, three rectal tracheal gills, and an external, conical tracheal-gill on each side of the first eight abdominal segments (Hagen 52).

The thin caudal tracheal-gills of the Agrioninæ are well supplied with tracheæ, but as the nymphs live after these are removed, Dewitz (25) suggests that here also the rectum may perform respiratory functions. No rectal tracheal-gills, however, have been found as yet in this subfamily, although the rectal walls are well supplied with tracheæ.

There are ten pairs of spiracles, as in the imago, and similarly distributed. They are all open, but those of the abdomen are probably not functional (Hagen 27, 52). The thoracic stigmata become functional at an earlier period in the nymphal life of the Agrionidæ and Libellulidæ than of the Aeschnidæ, but in all three cases only on one side of the body (Dewitz 25).

The *nerve-ganglia* occupy the same positions in the old nymphs as in the imago. In a Libelluline nymph, genus unknown, the writer found the meso- and metathoracic ganglia distinct, although nearer to each other than the former to the prothoracic pair; the same nymph had the testes well-developed. While each of the first eight abdominal segments of the young nymphs of *Ischnura verticalis* and *Libellula pulchella* has a pair of ganglia, all old nymphs, as far as known, have seven pairs as in the imago. In what way the reduction is effected is unknown, but the result is to leave the second abdominal segment without ganglia of its own (see p. 183).

The nymphs are ordinarily not very active, although when disturbed they can move quite rapidly, those of the Zygoptera by a serpentine movement of the abdomen, those of the Anisoptera by a series of "jerks," propelled by the water ejected from the rectum. Most of this period is spent clinging to the under surface of plants, sticks and stones, relying on a cautious approach and a sudden movement of the mask to obtain their living food.*

* The food of the nymphs has already been considered in connection with the alimentary canal of the imago, p. 177.

Still greater inactivity precedes the moults of the nymphal period, which are accomplished in the water. The fissures by which the nymph emerges from the exuvia are two, a transverse dorsal curved fissure passing across the top of the head through the middle or in front of the eyes, and a median longitudinal dorsal fissure extending from the first fissure as far back as the base of the hind wing-covers. The exuvia remains in one piece. From his studies on Odonate nymphs, Chatin (23) concludes that the "epidermal cells produce the chitinous coat not by secretion, but by a special process, which is to be considered as a direct emanation of their protoplasm transforming itself into chitinified strata."

When the time for the final transformation (imagination) arrives, the nymph crawls out of the water upon some object. The skin splits in the same lines as described above. In the Agrioninæ, at least, the first part of the imago to emerge is the anterior portion of the thorax, then the head, the feet, the wings and the abdomen. The last two are of course much smaller at this time than they will be. The imago lingers near where the transformation has taken place, until the wings and abdomen are stretched to their full extent. Belesme (22) thinks, from his observations on *Platetrum depressum*, that this inflation is accomplished by swallowing air and storing it in the alimentary canal.

The nymph-skin, left attached to the object by its feet, almost perfectly preserves its size and shape, and sometimes closes at the fissures so as to quite conceal them. The following measurements give the size of a nymph-skin and of the fully expanded imago, a female *Anax junius*, which came from it, the first dimension in each case being that of the exuvia:

Total length (including appendages) 45 mm., 67. Length of the head 7, 7. Greatest height of head 3.5, 8.5. Length of thorax 8, 14. Length of abdomen (incl. app.) 32.5, 46. Length of hind wing (cover 8.5), 49. Length of third femur 7.5, 10.

In recently transformed imagos the colors are pale, and a yellowish hue predominates; such are called *teneral* imagos. The characteristic color of the species appears after some hours. A sign of increasing age is a bluish or whitish powder, which appears on the body, especially of the males, and is known as *pruinoseness*. While the colors of the nymphs are dull, in harmony with that of their surroundings, and therefore protective, those of the imagos are usually bright, attractive and frequently brilliant.

The *range of size* of Odonate imagos extends from *Agriocnemis minima* Selys, of Java, whose abdomen measures 13.5 mm., the hind wing 8.5 mm.—to the Central American *Megaloprepus cærulatus* Drury (ab. 102, hind w. 94) and the South American *Mecistogaster amalia* Burm. (ab. 130, h. w. 85). The three species named are all Agrioninæ and have very slender bodies. The largest robust species is *Gynacantha plagiata* Waterh. (ab. ♂ 90, ♀ 67, hw. ♂ 65.5, ♀ 81), an Aeschnine of Borneo and Sumatra.

## 3. Distribution of the Odonata.

### Conditions determining distribution.

*Nature of the water in which the nymphs live.*—Owing to the aquatic life of the nymphs, the imagos absolutely must spend at least a portion of their lives in the neighborhood of fresh, or at the most, brackish water. No Odonate nymphs are known to live in salt water, but probably some coast species, such as *Ischnura Ramburii* and *Micrathyria berenice*, live in that which is brackish. Schwarz observed nymphs in shallow pools of mixed salt and sulphurous or fresh water on the flats near Great Salt Lake, Utah, and in sulphur creeks (Can. Ent. xxii, pp. 238–9).

*Temperature.*—Considerable heat is required for imagination, for activity during, and for the very existence of, imaginal life. Even in temperate climes the Odonata are only active in warm weather, cool, cloudy days in Summer causing them to take refuge in grass and foliage. Only one species of Odonata—the European *Sympycna fusca* Vander L.—is known to regularly hibernate as an imago in numbers (René Martin, Rev. Sci. Bourb. i, pp. 53–57), although some few imagos of *Diplax* do so. This ability means a greatly increased length of imaginal life, which for most Odonata varies from 25–45 days, but in *S. fusca* becomes nearly seven months (Martin). In the great majority of cases the Winter is probably spent in the nymphal state.

*Checks to Increase.*—Negative checks to increase may be due to the drying up of the water in which unhatched eggs have been placed, or to low temperature; the eggs do not seem to be well adapted to resist unfavorable conditions, judging from those reared in glass jars, although McLachlan found *Agrion mercuriale* ovipositing in soft mud where the water had evaporated. Positive checks are furnished by those animals which devour or injure the Odonata in different stages. Brandt (18) found more than half the eggs of *Calopteryx*

*virgo* in the river Wieseck, near Giessen, to be infested with the larvæ of *Polynema ovulorum* L., a minute Hymenopter of the family Chalcididæ. Minute Diptera and Acarina also oviposit in or devour the eggs (Mrs. Aaron 54, p. 50). These and the young nymphs provide food for fishes* and other aquatic animals; added to this is the cannibalism of the nymphs (see p. 178). The writer has found a young spider, kindly identified by Dr. McCook as *Dolomedes sexpunctatus* Hentz, feeding upon the soft parts of recently transformed imagos of *Ischnura verticalis* and *Nehalennia posita* which were not yet able to fly. The carnivorous habits of the Odonata naturally expose them to the entrance of intestinal parasites, and de Selys has recorded the finding of a *Filaria* in the abdomen of *Diplax flaveola*, inflating it to such an extent as to impede the insect's flight (Rev. Odon. d'Eur. p. 36). Red Acarina (mites) frequently occur on the thorax and abdomen of imagos, especially on the ventral side, and have been mistaken for eggs; a male of *Mesothemis simplicicollis*, communicated by Mr. H. F. Moore, had upwards of 100 such mites attached to the ventral surface of the sixth and seventh abdominal segments. During oviposition the female dragonfly sometimes falls a prey to fishes. Lastly, dragonflies are eaten by various kinds of birds.

Fisher (U. S. Dept. Agric. Div. Ornith. and Mam. Bull. No. 3, 1893) records the following Falconidæ as feeding on the Odonata in the United States: Swallow-tailed Kite (*Elanoides forficatus*), Sharp-shinned Hawk (*Accipiter velox*), Red-shouldered Hawk (*Buteo lineatus*), Broad-winged Hawk (*Buteo latissimus*), Duck Hawk (*Falco peregrinus anatum*), Pigeon Hawk (*Falco columbarius*) and Sparrow Hawk (*Falco sparverius*); none of these live exclusively upon dragonflies. Müller (Proc. Ent. Soc. Lond. 1871, p. xlii) quotes Natterer, who found "Libellen" in the stomach of a South American Falconid, *Hypotriorchis rufigularis*. In central France, "from May to September, in the pond countries where Odonata are naturally common, the Hoberean (*Falco subbuteo*) lives almost exclusively on the large Aeschnids, while the *Hydrochelidons* eat hardly anything but Agrions. Certain other birds also attack the Libellulæ at times, but none of them, even for a short season, make their exclusive diet thereon" (René Martin: Bull. Soc. Ent. France, 1891, pp. clxix–xxi). Gould states that he has frequently seen small birds, sparrows, etc., capture and eat the small species of Odonata frequenting the sedgy banks of the Thames (Proc. Ent. Soc. Lond. 1871, p. xlvii). Both Martin and Gould mention that the dragonflies were deprived of their wings before being eaten by the birds. Hersey (Can. Ent. v, p. 160) found the Kingbird (*Tyrannus carolinensis*) feeding upon Odonata in New Hampshire. Starlings, blackbirds and sparrows fed on a swarm of Odonata at Dresden, seen by Weid-

* Forbes gives a list of fishes in whose alimentary canals nymphs were found (Bull. Ill. State Lab. Nat. Hist. ii, p. 524).

inger (Ent. Nach. vii, p. 187). The Egyptian Bee-eater (*Merops persicus*) includes dragonflies in its diet (Allen, Ibis, 1862, p. 360).

*Means of Distribution.*—The highly-developed power of flight possessed by the Odonata constitutes a most efficient means of distribution, to which must be added the important aid afforded by the winds. Migratory swarms composed of many individuals of one or more species have frequently been observed. Köppen has brought together the records of sixteen migrations from 1494 to 1868 (Stett. Ent. Zeit. 1871, pp. 183–90), and Beutenmüller (54, pp. 161–2) adds twenty-six instances, mostly between 1872 and 1888. Representatives of the Calopteryginæ, Agrioninæ, Aeschninæ and Libellulinæ have taken part in such migrations, but the chief migratory species is *Libellula quadrimaculata*, swarms of which have been met with both in Europe and in North America. Annual migrations of this species occur in the Charente Inferieure according to Riveau, and a similar statement is made by Brown for *Aeschna eremita* (= *clepsydra* Say, see *post*) in Wisconsin. The cause of these migrations is unknown; in some cases they are believed to be due to the drying up of ponds, but this explanation does not appear to account for all the known instances.

Dragonflies have frequently been met with flying over the ocean, many miles from land, so that bodies of water of moderate size do not offer barriers to their dispersal. The observations of Schwarz (Proc. Ent. Soc. Wash. i, p. 208–15) lead to the conclusion, however, that many individuals do fall into the water and so perish.

The number of eggs laid by a single female is very variable, but often amounts to several hundreds, and each imago pairs more than once. As a considerable number of eggs are usually laid in each body of water, a number of imagos is to be expected at that locality, for at least a short period after imagination. Eggs and nymphs, however, are probably frequently transported from one place to another by currents of water.

## GEOGRAPHICAL DISTRIBUTION.

The Odonata are found over nearly all parts of the world, being, of course, more numerous in the tropics. Nowheres are they known to pass beyond the northern and southern limits of permanent human habitation, as these are shown by Bartholomew (Hand Atlas), but they probably occur above the northern limit of trees. The most northern localities known for these insects are near Alten, in Fin-

mark, Norway, 70° N., for *Somatochlora arctica;* Norton Sound, Alaska, 65° N., for *Aeschna juncea;* and the Wilui River, Siberia, 60°–63° N., for *Aeschna crenata* (*clepsydra*), *Leucorhinia rubicunda* and other species. The annual isotherm of O°C. (32° F.) passes above the first of these places, but below the other two, while a portion of the Wilui River is above the annual isotherm of — 10° C. (14° F.). Baron de Selys mentions a wing, considered by McLachlan to belong to *Somatochlora metallica*, collected by the Nordenskiold expedition at Port Dickson, near the mouth of the Jenesei, 73° 30′ N., but there is no knowledge as to whence it may have been carried by wind and wave. The most southern point at which dragonflies have been found is Bay St. Bernard, Hoste Island, Fuegian Archipelago, 55° 30′ S. for *Aeschna diffinis* Ramb. (Mabille), which, in point of temperature, does not compare with the northern locations mentioned.

Odonata occur in the mountainous regions of the world, but comparatively few precise records exist as to the elevations which they attain. *Allogaster latifrons* and *Cephalæschna orbifrons* have been taken at 10,000 ft. at Phulloth, in Bengal, *Ophiogomphus severus* at 9600 ft. in Colorado, *Epigomphus subobtusus* and *Cordulegaster Godmani* on the volcano of Irazu, Costa Rica (6000–7000 feet) and *Camicinia harterti* on Mt. Deli, Sumatra (8000 feet).

The number of described species of Odonata at the present writing (July, 1893) is shown in the following table:

| Subfamilies | Living throughout the world | | Fossil throughout the world | |
|---|---|---|---|---|
| | genera | species | genera | species |
| Calopteryginæ | 33 | 239 | 3 | 6 |
| Agrioninæ | 88 | 605 | 7 | 28 |
| Gomphinæ | 46 | 254 | 10 | 28 |
| Cordulegasterinæ | 5 | 27 | 1 | 3 |
| Aeschninæ | 23 | 126 | 2 | 12 |
| Cordulinæ | 22 | 146 | 1 | 2 |
| Libellulinæ | 104 | 525 | 3 | 26 |
| Total | 321 | 1922 | 27 | 105 |

The distribution of the living forms in the various zoö-geographical provinces is shown on the next page in a table which has been prepared for this paper by the writer's brother, Mr. Frederic B. Calvert; it is based on Kirby (35), but with the addition of such species as have been described, and corrections made since the publication of that Catalogue.

TABLE SHOWING THE TOTAL NUMBER OF GENERA AND SPECIES OF ODONATA OF EACH ZOO-GEOGRAPHICAL PROVINCE, WITH THE NUMBER OF GENERA AND SPECIES PECULIAR TO EACH.

PREPARED ESPECIALLY FOR THIS PAPER BY MR. FREDERIC B. CALVERT.

| Subfamilies. | Neotropical | | | | Nearctic | | | | Palaearctic | | | | Ethiopian | | | | Oriental | | | | Australian. | | | | Polynesian | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Total | | Peculiar | | Total | | Peculiar | | Total | | Peculiar | | Total | | Peculiar | | Total | | Peculiar | | Total | | Peculiar | | Total | | Peculiar | |
| | G. | Sp. | G. | Sp. | G. | Sp. | G. | Sp. | G. | Sp. | G. | Sp. | G. | Sp. | G. | Sp. | G. | Sp. | G. | Sp. | G. | Sp. | G. | Sp. | G. | Sp. | G. | Sp. |
| Calopteryginæ | 10 | 96 | 9 | 88 | 2 | 18 | 0 | 17 | 6 | 26 | 1 | 25 | 5 | 17 | 1 | 16 | 16 | 88 | 9 | 84 | 4 | 11 | 0 | 9 | 0 | 0 | 0 | 0 |
| Agrioninæ | 40 | 219 | 28 | 188 | 12 | 56 | 0 | 47 | 14 | 73 | 0 | 71 | 22 | 59 | 10 | 59 | 26 | 125 | 8 | 117 | 21 | 65 | 9 | 61 | 8 | 25 | 3 | 24 |
| Gomphinæ | 15 | 60 | 10 | 55 | 9 | 50 | 2 | 49 | 12 | 52 | 0 | 51 | 12 | 26 | 7 | 25 | 15 | 59 | 6 | 59 | 5 | 11 | 3 | 11 | 0 | 0 | 0 | 0 |
| Cordulegasterinæ | 4 | 8 | 3 | 7 | 1 | 8 | 0 | 7 | 2 | 10 | 0 | 10 | 0 | 0 | 0 | 0 | 3 | 3 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Aeschninæ | 9 | 43 | 3 | 31 | 6 | 24 | 2 | 15 | 7 | 30 | 3 | 24 | 5 | 16 | 1 | 15 | 9 | 23 | 3 | 20 | 8 | 11 | 3 | 9 | 2 | 3 | 0 | 2 |
| Cordulinæ | 4 | 12 | 3 | 11 | 7 | 34 | 4 | 34 | 7 | 16 | 2 | 16 | 5 | 12 | 3 | 12 | 5 | 15 | 1 | 16 | 8 | 22 | 4 | 21 | 2 | 5 | 0 | 3 |
| Libellulinæ | 41 | 132 | 22 | 109 | 17 | 68 | 2 | 56 | 20 | 85 | 4 | 74 | 32 | 87 | 15 | 79 | 36 | 123 | 5 | 99 | 30 | 73 | 9 | 53 | 8 | 9 | 0 | 8 |
| Totals | 123 | 570 | 78 | 489 | 54 | 258 | 10 | 225 | 68 | 292 | 10 | 271 | 81 | 217 | 37 | 206 | 110 | 436 | 32 | 398 | 76 | 193 | 28 | 164 | 20 | 42 | 3 | 37 |

G. = genus. Sp. = species.

The limits of the provinces employed in the above table are as follows:

Neotropical: Tropical Mexico, Central America, West Indies, South America and the adjoining islands.

Nearctic: America north of Mexico.

Palaearctic: Europe, Asia north of the watershed of the Yang-tse-Kiang and the Himalayas and west of the Indus, Africa and Arabia north of the Tropic of Cancer, and the islands immediately adjoining these countries, Japan, etc.

Ethiopian: Africa and Arabia south of the Tropic of Cancer, Madagascar and the adjacent isiands.

Oriental: Asia east of the Indus and south of the Himalayas and the watershed of the Yang-tse-Kiang, Ceylon, Sumatra, Java, Borneo and the Philippines.

Australian: Australia, Tasmania, New Zealand, New Guinea, Celebes and the intervening islands.

Polynesian: The islands of the Pacific from the Australian province on the west as far east as and including the Sandwich Islands, the Marquesas and the Low Archipelago.

The Calopteryginæ are most abundant in the Neotropical and Oriental provinces, but the most widely distributed genus is *Calopteryx*, which is Palaearctic and Nearctic. None of this subfamily are Polynesian.

The Agrioninæ are cosmopolitan; the genera *Lestes* and *Ischnura* are world-wide, *Argia* is of both Americas and the Kurile Islands, *Agrion* is Palaearctic, Nearctic and Oriental, *Pseudagrion* and *Disparoneura* are of the Old World from West Africa to Australia and Borneo, and the most widely distributed species is *Enallagma cyathigerum* of the upper parts of Europe, Asia and North America.

No Gomphinæ are Polynesian. *Gomphus* occurs throughout the northern hemisphere.

The Cordulegasterinæ are Neotropical, Nearctic, Palaearctic and Oriental. *Cordulegaster* ranges through the northern hemisphere.

The Aeschninæ and two genera thereof, *Anax* and *Aeschna*, are cosmopolitan. *Gynacantha* is of the tropical and subtropical regions around the globe.

The Cordulinæ and Libellulinæ are world-wide. Of the former *Somatochlora* extends throughout the cooler parts of the northern hemisphere. Among the latter are *Pantala flavescens*, the most widely distributed species of Odonata, being found in America, Asia, Africa and the Pacific (see Part II); *Orthetrum*, of all parts of the Old World, *O. sabina* ranging from the Fijis to the Cameroons; *Libellula quadrimaculata* and *Diplax scotica* of the upper parts of the northern hemisphere; and *Crocothemis erythræa* of Southern Asia, Europe and Africa.

## GEOLOGICAL DISTRIBUTION.

Fossil remains of Odonata have been found as far down as the Lower Lias in England and Germany, although two fragments of wings from the Devonian of New Brunswick and named by Scudder *Platephemera antiqua* and *Gerephemera simplex*, really belong to the Odonata according to Hagen (Bull. Mus. Comp. Zool. viii, pp. 276, 277).

According to Kirby (35) the beds which have yielded them are in England the Lower Lias of Strensham, Binton and Cheltenham, the Upper Lias of Dumbleton, the Purbeck of Swanage and the Vale of Wardour; in France the Eocene of Provence and the Miocene of Auvergne; in Germany the Lower Lias of Schambelen, the lithographic slates (Oolite) of Solenhofen, Eichstatt and Pappenheim, and the Miocene of Oeningen, Schossnitz, the Brown coal of Rott and Sieblos, the amber of East Prussia; in Italy, the Eocene of Monte Bolca; in Croatia, the Oligocene of Radoboj; in the United States the Eocene of the Green River shales of Wyoming, and the Oligocene of Florissant and Roan Mountains, Colorado; in Queensland, the Cretaceous.

The Calopteryginæ are represented in the lithographic slates by the living genus *Euphea* and the extinct *Isophlebia* and *Tarsophlebia*. Of the Agrioninæ are the living genera *Agrion* (Solenhofen, Florissant, Amber, etc.), *Megapodagrion* (Green River), *Trichocnemis* (Florissant), and *Lestes* (Radaboj, Oeningen, Sieblos) and the extinct *Dysagrion* (Green River), *Lithagrion* (Florissant) and *Agrionidium* (English lower Purbeck). Belonging to the Gomphinæ are the living *Gomphus* (Vale of Wardour, Amber), *Gomphoides* (Dumbleton, Amber), *Ictinus* (Rott) *Uropetala* (lithographic slate) and *Petalura* (id., Sieblos), and the extinct *Protolindenia*, *Stenophlebia*, *Cymatophlebia* (all lithographic stone), *Heterophlebia* (English

Lias, lithographic stone, Sieblos) and *Stenogomphus* (Roan Mountain). *Cordulegaster* occurs in the lithographic stone. *Anax* (Radoboj) and *Aeschna* (Schambelen, lithographic stone, Wardour, Queensland Cretaceous, Florissant, Oeningen, Rott) are living Aeschninæ. Radoboj and Monte Bolca have yielded the living *Cordulia*. Lastly, for the Libellulinæ are the extinct *Aeschnidium* (Swanage, lithographic stone) and *Libellulium* (Swanage, Wardour), and living "*Libellula*" (English Lower Lias, lithographic stone, Provence, Auvergne, Oeningen, Schossnitz, Rott).

The oldest Odonate remains are therefore of the Gomphinæ, Aeschninæ and Libellulinæ from the Lower Lias. The Calopteryginæ, Agrioninæ and Cordulegasterinæ are first found in the Oolite. The oldest known Cordulinæ are of Eocene age. The value of this paleontological evidence will be discussed later.

## 4. Relationships of the Odonata.

### Relationships to other insects.

The insects to which the Odonata are most nearly related, are the Ephemerina and the Perlina. All three groups, besides passing through an incomplete transformation, agree in the possession of three ocelli, numerous Malpighian tubules, and of aquatic nymphs which breathe by tracheal-gills.

The Odonata and the Ephemerina constitute the Subulicornia of Latreille, by reason of their short, subulate (awl-shaped) antennæ; other agreements are the relatively small size of the prothorax to the other thoracic segments in the imago, but not in the nymph, and the absence of a part which may be closed as a fan in the hind wings—characters which are the opposite of those of the Perlina. The three terminal jointed setæ of the Ephemerine nymphs, clothed with short bristles, recall the three caudal, though jointless,* tracheal-gills of the nymphs of the Zygoptera, which at hatching are setiform and sparsely hairy, and in the Calopterygine genus *Euphœa*, remain setiform and hairy for at least the apical half of their length. The nymphs of *Euphœa* also have a lateral gill on each side of abdominal segments 1–8, another resemblance to the Ephemerine nymphs in which such gills exist on 1–7. But in almost all other respects the Ephemerina differ from the Odonata in that their imagos have their mouth-parts more or less atrophied and functionless, the tarsi four- or five-jointed, the wings of unequal length, the venation different, the terminal abdominal appendages (setæ) jointed, and want the characteristic separated accessory genital organs of the male Odonata.

* Nymphs of *Lestes* show traces of an articulated structure in the stems of the caudal tracheal-gills.

With the Perlina the Odonata have little more in common than as stated above; however, the former have three-jointed tarsi and the mouth-parts function as biting organs, although in structure they are quite different from those of the Odonata; the Perlina have eight pairs of abdominal ganglia.

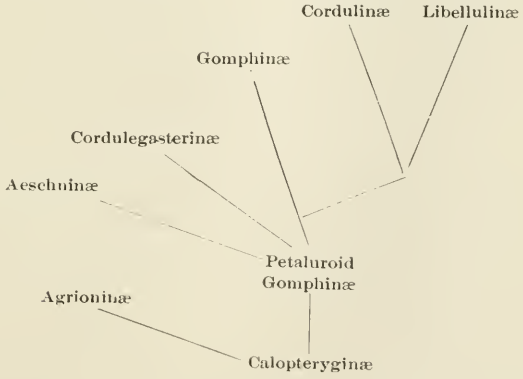
While, therefore, the Odonata are more nearly related to the Ephemerina, the differences separating the two groups are still considerable.

As the common ancestral form of the Perlina, Ephemerina and Odonata, Mayer suggested the *Protamphibion* characterized by having eleven free abdominal segments, prothorax freely movable, head fixed, biting mouth-parts, wings equal, three ocelli, tarsi five-jointed, three thoracic and seven abdominal ganglia, 20–50 Malpighian tubules, no ovipositor (legescheide); development with internal germinal band, larva with three pairs of legs, similar to the imago (Jen. Zeit. Naturw. x, p. 202, 1876).

The Odonata also possess primitive Insectan features in that the embryo is developed from an invaginated germinal band, recalling the manner of development of the Myriapods (Korschelt and Heider 18), and in the preservation throughout life of ten distinct abdominal segments with a terminal anal segment—a number which appears to be constant for the early embryonic stages of all insects.

### RELATIONSHIPS OF THE ODONATE GROUPS TO EACH OTHER.

The writer's view of the relationship of the subfamilies of the Odonata to each other may be best expressed by the accompanying diagram, in which the Calopteryginæ are represented as the most




primitive and least specialized. That at least some Calopteryginæ are less specialized than all the other Odonata, or in other words differ less from other Insects, seems to be indicated by the simulta-

neous possession of the following structural features: for the imago, the relatively less extent of the eyes, the less degree of fusion shown in the labium, the completeness of the first lateral thoracic suture (*i. e.* a less intimate union of meso- and metathorax), and the distinctness of meso- and metathoracic ganglia; for the nymph, a greater resemblance to Ephemerine nymphs by the possession of three, originally setiform, caudal tracheal-gills, and of lateral abdominal tracheal-gills (*Euphœa*).

If this starting point be accepted, the Agrioninæ, admittedly the nearest allies of the Calopteryginæ, form a group having no relationship to the other subfamilies save by a common descent from Calopterygine ancestors. Approaches to connecting forms between the two groups are furnished, as De Selys (40) long ago suggested, by the exotic Calopteryginæ *Amphipteryx* and *Micromerus*. Of the Agrioninæ, the legion Lestes stands nearest the Calopteryginæ by the point of origin of its subnodal and median sectors. The legion Agrion is the most specialized of its subfamily; of its genera, *Argia* is probably the oldest phylogenetically, and the line of descent from it may run through *Agrion, Enallagma* or *Nehalennia*, and *Ischnura* to *Anomalagrion*. With such a phylogenetic series the views of Kolbe (3) agree—that the male appendages, which are the essential supports in copulation, gradually lose their relative size; that to supply this deficiency emarginations and lobes are formed on the hind margin of the prothorax of the female, and that in accommodation to the shape of this last, the tenth segment of the male becomes emarginated or provided with bifid processes.

Of living Anisoptera, the Gomphinæ of the legion Petalura of Selys most nearly approach the Calopteryginæ in that they have the eyes separated, the median lobe of the labium bifid, the vulvar laminæ formed as an ovipositor and with genital valves. We know nothing of their nymphs. There are but four living genera, viz.: *Petalura* with one species from Australia, *Uropetala* with one species from New Zealand, *Tachopteryx* with two species from the United States and one from Japan, and *Phenes* with one species from Chili. Four fossil species have been referred to *Uropetala* and three to *Petalura* (Kirby 35).

Derived from Petaluroid forms, three lines of descent may be conceived. One of these is that of the Aeschninæ which preserve the ovipositor, the genital valves and the distinctness of meso- and metathoracic ganglia, but in which the median labial lobe is entire, the

eyes are united on the top of the head, and the abdomen develops lateral longitudinal carinæ; here are the most powerful in flight of all Odonata.

As a second line from the Petaluroid forms, come the Cordulegasterinæ;* here the median lobe of the labium remains cleft, the eyes, although often meeting dorsally, do so only in a single point, but the genital valves disappear.

Thirdly are the bulk of the Gomphinæ which ultimately have the median labial lobe entire, lose the genital valves and the ovipositor, have the meso- and metathoracic ganglia united, but preserve the primitive characters of separated eyes and absence of lateral abdominal carinæ.

From some point along the Gomphine line, the Libellulidæ can be conceived as having arisen. From Gomphine ancestors they inherited the absence of an ovipositor, and perhaps the union of the last two thoracic ganglia; the eyes meet upon the top of the head, the labium loses all trace of the bifid (bilateral) character of the median lobe, which is quite small as compared with the lateral lobes; a change takes place in the venation of the wings, so that the triangle of the front wings is elongated in the direction of the short axis of the wing, and the triangle of the hind wings (in the more specialized genera) although retaining its direction of elongation, comes to lie with its inner side in the prolongation of the arculus; and lateral carinæ appear on the abdomen. The relationship between the two subfamilies of the Libellulidæ is not yet apparent; the most important systematic character separating them is a small tubercular projection present on the hind margin of the eyes of the Cordulinæ. Perhaps we are to look upon such Corduline genera as *Somatochlora* as the most specialized of all the Odonata.

The preceding view of the relationships of the various groups to each other is based entirely on morphological evidence. There is, apparently, only one important morphological fact which is not in favor of regarding the Calopteryginæ as the most primitive group, and that is that these dragonflies have an ovipositor, while neither the Perlina nor the Ephemerina possess such. For this reason Mayer regarded the Libellulidæ as most approaching the hypothetical Protamphibion, one of whose characters (see above) was "no ovipositor;" he consequently looked upon the Agrionidæ on one hand and the Aeschnidæ on the other, as derived from a Libellulid stock. If the Protamphibion did not have an ovipositor, to look upon the Calopteryginæ as the writer does, means that the Gom-

* Here and elsewhere throughout this paper the subfamily Cordulegasterinæ is equivalent to the legion Cordulegaster of Selys alone, and not of the extent of the Division Cordulegasterina of Kirby (35).

phinæ and Libellulinæ have reverted to the far back ancestral peculiarity in this respect. On the other hand, to accept Mayer's view means that the ephemerine appearance of the nymphs, the separation of the eyes, the cleft labium, the completeness of the first lateral thoracic suture, and the distinctness of the last two thoracic ganglia of the Calopteryginæ are all reversions. If the absence of an ovipositor really be of great importance, the Gomphinæ ought to offer more primitive characters than the Libellulidæ, but the view taken above seems the most satisfactory to the writer.

No embryological evidence for the solution of the question exists as yet. The paleontological evidence, as already set forth, tells of the existence of Libellulinæ, Gomphinæ and Aeschninæ in the Lower Lias, and nothing of the Calopteryginæ until the Oölite, but at the meeting of the Entomological Section of the Philadelphia Academy of Natural Sciences, held May 25, 1893, at which the writer brought the matter up for discussion, Dr. S. H. Scudder expressed the opinion that the scantiness of fossil Odonata did not give weight to any negative arguments based on their non-discovery.

The writer had written the above statement of his views of the phylogeny of the Odonata before he had read the brief expressions of Kolbe and Redtenbacher tending to the same opinion. Kolbe (Berl. Ent. Zeit. xxviii, p. 393, 1884) says of the "Agrioninen" that they are of the lowest stage of Odonate organization by their separated eyes, prothorax still moderately large, almost equal wings, pterostigma differing rarely from the other cells, and external tracheal-gills in the larvæ. Redtenbacher writes "While it seems doubtful to me to look upon the Gomphidæ as the oldest forms of the Odonata, I think that I recognize in the wing of *Calopteryx* that form from which the wing-forms of the other Odonata are derived" (Ann. k. k. Naturhist. Hofmus. Wien, i, p. 167, 1886).

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*Note on the Preservation of Specimens.*

For the ordinary systematic collection of dried Odonata, it is *always* advisable to insert in every specimen, when it is mounted a bristle, or a fine non-corrosive wire, beginning at the nasus and passing it through the entire length of the body, but not allowing it to project beyond the eleventh (anal) segment. This holds the various parts of the body together. The thickness of the bristle should conform to the size of the specimen. If it be desired to preserve the coloring of the body, it is of some advantage to make a longitudinal cut on the ventral surface of the abdomen and even the thorax, remove the contents, and insert a wad of cotton; in doing so, the body wall must not be rubbed or scratched by the instruments employed. Some specimens of each species should always be preserved intact, as the cutting usually destroys or distorts some of the abdominal structures, which are of more importance for study than the colors. Nymphs and specimens for dissection may be preserved by killing them, or placing them immediately after death, in hot, but not boiling alcohol of 50 to 60 per cent. for three or four hours, then transferring them to (cold) alcohol of 75 to 80 per cent. in which they may be kept indefinitely. *N. B.*—The vessel containing the alcohol to be heated must be placed in another vessel containing water and thus heated indirectly to avoid the danger of explosion. For methods of technique for histological purposes, recourse must be had to the histological papers quoted in the Bibliography.

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# PART II.

## CATALOGUE OF THE ODONATA OF THE VICINITY OF PHILADELPHIA.

### Characters of the Major Groups.

SUBORDER I. ZYGOPTERA.—Front and hind wings similar in shape or nearly so, usually elevated in repose; no membranule; with an unmodified quadrilateral. Males with two inferior, terminal, abdominal appendages, penis and its vesicle separate. Nymphs with three caudal tracheal-gills.

FAMILY 1. AGRIONIDÆ.—Head transversely elongated; eyes separated from each other; lateral lobes of the labium of two* joints, middle lobe bifid. Females with genital valves.

*Subfamily* 1. *Calopteryginæ.*—At least five, and usually more antecubitals.

*Subfamily* 2. *Agrioninæ.*—Two, occasionally three, antecubitals, wings stalked at base, quadrilateral not cross-veined (except in the S. Amer. *Anomisma*).

SUBORDER II. ANISOPTERA.—Wings dissimilar, hind wings usually broader at base; horizontal in repose; usually with a membranule; quadrilateral modified to form a cardinal cell (triangle) and a supratriangle. Males with one inferior, terminal, abdominal appendage, penis and its vesicle connected. Nymphs without caudal tracheal-gills.

FAMILY 2. AESCHNIDÆ.—Triangles of front and hind wings of similar shape (except in some Gomphinæ). Antecubitals of first and second series not coincident, except the first and one other (the latter is variable in position), which two are thicker than their fellows. Postcubitals in the entire second series. Lateral lobes of the labium of two* joints. Males often with auricles on 2, and the anal margin of the hind wings excavated.

*Subfamily* 3. *Gomphinæ.*—Head transversely elongated, eyes separated. Abdomen without lateral carinæ. Females without genital valves (except in the legion Petalura).

*Subfamily* 4. *Cordulegasterinæ.*—Head transversely elongated, eyes a little separated, or meeting in a single point dorsally. Abdomen without lateral carinæ. Females without genital valves.

*Subfamily* 5. *Aeschninæ.*—Head globose, eyes meeting on the top of the head for a space. Abdomen with lateral carinæ. Females with genital valves.

FAMILY 3. LIBELLULIDÆ.—Triangle of front wings with its long axis at right angles to the length of the wing, triangle of hind wings with its long axis coinciding with that of the wing. Antecubitals of first and second series mostly coincident. No postcubitals in the nodal end of the second series. Lateral lobes of the labium of one† joint. Head globose, eyes meeting on the top of the head. Abdomen with lateral carinæ. Females without genital valves.

* *l. e. ll* and *tp* of fig. 7, pl. II.

† *l. e. ll* of fig. 7, pl. II.

*Subfamily* 6. *Cordulinæ.*—Hind margin of eyes produced as a small tubercle. Usually a small bundle of fine hairs on the distal anterior surface of the first femora. Males with auricles on 2, anal margin of hind wings excavated, distal end of first tibiæ with an inferior carina.

*Subfamily* 7. *Libellulinæ.*—Hind margin of eyes not produced as a small tubercle, or with a mere trace of such. Males without auricles on 2, anal margin of hind wings not excavated.

## Characters of the Genera (imagos only).

### Subfamily 1. CALOPTERYGINÆ.

*Legion Calopteryx* Selys.—Sectors of the arculus arising from below its middle, antecubitals of first and second series nearly equal in number, quadrilateral as long as the basilar space, pterostigma absent or of one to several cells. Epistoma not projecting as much as the length of the eyes.

Basilar space free, arculus broken, an inferior branch to the lower sector of the triangle; quadrilateral straight; ♂ superior appendages forcipated; no pterostigma; ♀ pterostigma absent or present.....1. **Calopteryx.**

Basilar space cross-veined, arculus not broken, no inferior branch to the lower sector of the triangle; ♂ wings with a basal red spot, cells of postcostal space on front wings irregular..... ..... 2. **Hetærina.**

### Subfamily 2. AGRIONINÆ.

*I. Legion Lestes* Selys.—Median and submedial sectors parting from the principal sector much nearer the arculus than the nodus; ♂ superior appendages forcipated.

Nodal sector parting from the principal 3–5 cells after the nodus; supplementary sectors between the submedial and the median, and the median and the short and other sectors; hind margin of the prothorax rounded, entire; pterostigma 3–4 times as long as broad .....3. **Lestes.**

*II. Legion Agrion* Selys.—Median and submedial sectors parting from the principal near the nodus; quadrilateral trapezoidal, upper side shorter than the lower, lower external angle acute; no supplementary sectors except the ultra-nodal; lower sector of the triangle extending to the hind margin of the wing; pterostigma of but one cell.

Hairs of the tibiæ about twice as long as the intervals between them; a single row of postcostal cells; arculus complete, lying in the prolongation of the second antecubital; tarsal nails toothed, tooth shorter than the nail proper..... .....4. **Argia.**

Hairs of the tibiæ never twice as long as, but generally shorter than, the intervals between them; otherwise as in *Argia*. (In all the following genera the postcostal vein separates from the hind margin in front of the basal postcostal cross-vein.)

A. ♀ with no apical ventral spine on 8. Pterostigma similar on front and hind wings.

No pale postocular spots; color brown and blue or yellow.....5. **Erythromma.**

Pale postocular spots or line present; color metallic, similar in ♂ and ♀; abdomen extremely slender.....6. **Nehalennia.**

B. ♀ with an apical ventral spine on 8.

No pale postocular spots.

Pterostigma similar on front and hind wings; color red; ♂ with no bifid process on dorsum of 10.....7. **Amphiagrion.**

A pale (postocular) spot behind each eye.

Pterostigma of ♂ similar in color on front and hind wings, no dorsal bifid process on 10 (except in *E. exsulans* ♂). Nodal sector (♂ ♀) arising near 5th postcubital on front wings, 4th on hind wings, or more remote.....8. **Enallagma.**

Pterostigma of ♂ dissimilar in color on front and hind wings, 10 with a dorsal process (♂) bifid at its apex.

Pterostigma of ♂ touching the costa on front wings, darker than on hind wings. Front wings (♂ ♀) with usually more than 7 postcubitals. (The species included in this catalogue have the nodal sector usually arising at the 4th postcubital on the front wiugs, at the 3rd on the hind wings; this aids in distinguishing from *Enallagma*.)

9. **Ischnura.**

Pterostigma of ♂ not touching the costa on the front wings. Front wings (♂ ♀) with usually, but not always, less than 7 postcubitals. Nodal sector arising not farther than the 4th postcubital.

10. **Anomalagrion.**

## Subfamily 3, GOMPHINÆ.

I. Median labial lobe bifid.

*Legion Petalura* Selys.*—Basilar space free; triangles of front wings crossed; membranule very small; ♀ with genital valves.

Triangle of front wings with the upper side longer than the inner, the outer longest; hair-like termination of antennæ jointed; ♂ superior appendages not more than twice as wide in front of apex as at base, inf. app. more than half as wide at base as long.....11. **Tachopteryx.**

II. Median labial lobe entire: basilar space free. No genital valves.

*Legion Gomphoides* Selys.—All or some of the triangles crossed; membranule wanting, or very small.

Feet long, hind femora reaching backwards to base of 3; discoidal triangles crossed, internals and supratriangular spaces free; abdomen blackish, with a dorsal yellow stripe.....12. **Hagenius.**

*Legion Gomphus* Selys.—All the triangles and the supratriangular spaces free; membranule wanting, or very small.

♂. Inferior appendage bifid, its branches almost contiguous. 10 considerably shorter than 9. ♂ inf. app. bifid in its apical half, branches straight, upcurved at apex. ♀. Vulvar lamina nearly as long as 9 (except in the European *O. serpentinus*), divided into two narrow, quite long, parallel, almost contiguous branches, pointed at their apices.

13. **Ophiogomphus.**

* It may hereafter be necessary to regard this as representing a distinct subfamily—the Petalurinæ.

♂. Inferior appendage bifid, its branches divergent; superior appendages at most but little longer than 10, their divergence but little different in width from that of the branches of the inferior; lateral margins of 8 not dilated into membranous appendages; 2nd joint of penis usually with a tooth; a salient anal angle. ♀. Vulvar lamina at most hardly longer than half of 9. 10 considerably shorter than 9 (♂ ♀).

Third femora moderate (when extended backwards reaching no farther than the middle of 2). all the spines short, numerous.....14. **Gomphus.**

Third femora long (when extended backwards reaching to base of 3), with an antero-inferior row of 5–7 spines which are considerably longer than the more numerous short spines .....15. **Dromogomphus.**

Subfamily 4. CORDULEGASTERINÆ.

Frons not elevated as high as the occiput, wings not spotted. ♂ with auricles on 2.....16. **Cordulegaster.**

Subfamily 5. AESCHNINÆ.

I. Upper piece of the arculus equal to or longer than the lower piece, its upper sector arising a short distance above the lower sector, being separated from the latter by a distance $\frac{1}{2}$–$\frac{1}{3}$ of that separating the upper sector from the median nerve. ♂ hind wings with anal triangle, distinct anal angle, auricles on 2.

Supplementary sector between the subnodal and median sectors curved at its middle *towards* the former or its posterior fork to be almost parallel, and separated by 1–2 (rarely 3) rows of cells.

Subnodal sector forked at its extremity.

Subcostal vein not prolonged beyond the nodus; basilar space free; pterostigma long, narrow; median space with at least 2 cross-veins in addition to that forming the internal triangle; two rows of cells between subnodal sector and the supplementary sector next below it. ♂ anal triangle of 3 cells.....17. **Epiaeschna.**

Subnodal sector not forked or branched.

Basilar and supra-triangular spaces cross-veined...18. **Fonscolombia.**

Basilar and supra-triangular spaces free.....19. **Gomphaeschna.**

Supplementary sector between the subnodal and median sectors curved at its middle *away* from the former or its posterior branch, with 3–7 rows of cells between them at that place.

Subnodal sector forked or with several small branches; suture between the eyes short or moderately long (*i. e.* not longer than combined length of vertex and frons measured on mid-dorsal line); subcosta not prolonged beyond the nodus.....20 **Aeschna.**

II. Upper piece of the arculus shorter than the lower piece, its upper sector arising close to the median vein (midway between the latter and the lower sector). ♂ hind wings without anal triangle, anal angle rounded off, no auricles on 2.

External branch of lower sector of the triangle in hind wings approaching the upper sector for its apical half, being parallel to it and separated by one row of cells; 4 (♂) or 5 (♀)—10 usually with a supplementary lateral carina above the usual one.....21. **Anax.**

Subfamily 6. CORDULINÆ.

*I. Legion Macromia* Selys.—Supra-triangular space crossed; triangle of the front wings regular, with the anterior side unbroken; membranule large; sectors of the arculus more or less united at their origins.

Basilar space free; inner side of triangle of hind wings farther from the base than the arculus; two posttriangular rows (rarely one) on the front wings.

Eyes touching for hardly more than a point; occiput quite prominent on the dorsal surface of the head and considerably larger than the vertex; distance from nodus to pterostigma on costal border of front wings more than half as long as from base to nodus; all triangles free.

22. **Didymops.**

Eyes touching for a short dsitance; occiput inconspicuous and much smaller than the vertex; triangles crossed or free.....23. **Macromia.**

*II. Legion Cordulia* Selys.—Supratriangular space free; sectors of the arculus almost always separate at their origins.

Triangle of the front wings regular, anterior side unbroken; membranule moderate or large.

Wings with dark spots at base, apex and frequently at nodus; triangle of hind wings crossed; abdomen slightly depressed, longer than hind wings; one cross-vein immediately beneath the pterostigma. ♀. Vulvar lamina almost as long as 9, deeply bilobed.....24. **Epicordulia.**

Hind wings with some black at base; triangle of hind wings free; abdomen depressed, as long as, or a little shorter than hind wings; one cross-vein immediately beneath the pterostigma. ♀. Vulvar lamina at least as long as 9, deeply bilobed.....25. **Tetragoneuria.**

Wings with small dark spots at base and along front margin; triangle of hind wings crossed or free; abdomen usually longer than hind wings; two cross-veins immediately beneath the pterostigma. ♀. Vulvar lamina not more than half as long as 9, divided into two divaricate, triangular plates.....26. **Neurocordulia.**

Wings without dark spots; triangle of hind wings crossed or free; colors metallic.....27. **Somatochlora.**

Subfamily 7. LIBELLULINÆ.

I. Lower angle of triangle of front wings placed as far beyond the level of the outer angle of the triangle of the hind wings, as the latter triangle is long; eyes connected for a space at most not much greater than the thickness of the vertex; no antenodal concavity on front margin of wings.

Ab. seg. 3 and 4 with two additional transverse carinæ, 5 with one; nodal sector waved.....28. **Pantala.**

Ab. seg. 3 and 4 with one additional transverse carina, 5 with none; sectors of the arculus arising from a common stalk; triangle of front wings crossed, nodal sector not waved or broken.....29. **Tramea.**

II. Lower angle of triangle of front wings placed on a level with the outer angle of the triangle of the hind wings, or only a little beyond it; tarsal nails toothed; otherwise as in (I).

Hind lobe of the prothorax with its middle portion produced upwards and backwards and *narrower* than the other lobes, its hind margin usually entire; triangle not densely reticulated.

Sectors of the arculus in the front wings not arising by a common stalk; nodal sector distinctly waved in its middle: front wings with supratriangulars, 11 or more antecubitals, 8 or more postcubitals.

♂ with no ventral hooks on 1; ♀ with third tibiæ at least a little longer than third femora.....30. **Libellula.**

♂ with a pair of ventral hooks on 1; ♀ with third tibiæ as long as third femora .....31. **Plathemis.**

Sectors of the arculus in front wings arising by a common stalk.

Anterior side of triangle of front wings not broken to form a trapezium; last antenodal on front wings not continued to the median vein; lower sector of the triangle in hind wings arising from the hind angle, the upper from the outer side of the triangle.

32. **Micrathyria.**

Anterior side of triangle of front wings broken to form a trapezium, the outer broken piece shorter than the inner; no supratriangulars; hind wings with no internal triangle.....33. **Nannothemis.**

Hind lobe of the prothorax erect, *wider* than the other lobes, its hind margin usually bilobed.

Both sectors of the triangle in the hind wings arising from its hind angle; nodal sector not waved in its middle.

Abdomen at least fairly slender, compressed at base; if depressed it is so in a special widening of the anteapical segments; hamule of ♂ bifid.

Pterostigma at least four times as long as wide: vertex truncated at tip; front wings with 7–10 antecubitals, the last one variable; hind wings with at least two dark brown basal patches, one in front of the other, and separated by a clear yellow space, the front one reaching forwards to the submedian vein; 3–7 black with a middorsal, maculate, yellow band.....34. **Celithemis.**

Pterostigma at most twice as long as wide; vertex rounded at tip; front wings with 6–8 antecubitals, the last one usually continued to the median vein; hind wings with a small basal black patch reaching forwards to the submedian vein: frons and nasus white; abdomen not widened at base and before apex. .....35 **Leucorhinia.**

Pterostigma variable; vertex truncated at tip; front wings with 7–10 antecubitals, the last one rarely continued to the median vein; abdomen and hind wings without the characteristic patterns of coloring described for *Celithemis* and *Leucorhinia*.....36. **Diplax.**

Abdomen at least fairly stout, depressed, tapering to apex; hamule of ♂ not bifid; front wings with last antecubital not continued to the median vein; 4 with an additional transverse carina.

37. **Perithemis.**

Lower sector of the triangle in the hind wings arising from its hind angle, the upper from its outer side; sectors of the arculus in the front wings arising by a common stalk; hamule of ♂ bifid.

Last antecubital of front wings usually not continued to the median vein : third tibiæ with the spines of the antero-inferior row few (5–7) and stout; abdomen stout, hardly as long as the hind wings.

38. **Mesothemis.**

Last antecubital on front wings continued to the median vein; vertex truncated at tip; front wings with not more than 7 antecubitals, triangle crossed, 3 rows of posttriangular cells..39. **Pachydiplax.**

## Systematic Characters of Nymphs.*

I. Three caudal tracheal-gills (Zygoptera).

*Legion Calopteryx.*—Basal joint of antennæ thick, more than twice as long as the other six together. Median lobe of labium bifid.

Front edge of median lobe of labium bifid to form a lozenge-shaped interval between, which extends basally beyond the level of the attachment of the lateral lobes. Rear of head with a tooth each side. Median caudal gill flat, shorter than the other two...1. **Calopteryx** (see fig. 8, pl. II.)

Front margin of median lobe of labium bifid only as far basally as the level of the attachment of the lateral lobes. Abdominal segments with a lateral membrane whose margins are denticulated. Median caudal gill a little swollen at apex..... .....2. **Hetærina.**

*Subfamily Agrioninæ.*—Basal joint of antennæ hardly longer than thick, much shorter than the second or the third.

Lateral lobes of labium (excluding the terminal palp) deeply bilobed, median lobe barely bifid.....*Legion Lestes.*

Lateral lobes of labium (excluding the terminal palp) not deeply bilobed, median lobe entire.....*Legion Agrion.*

The veins on the wing-covers will assist in determining between these two legions as in the imagos.

II. No caudal tracheal-gills (Anisoptera).

*Subfamily Gomphinæ.*—Antennæ 4-jointed, fourth joint rudimentary; first and second tarsi 2-jointed; labium flat, not covering the labrum or frons when closed.

First legs less distant from each other at base than are the second legs. Abdomen much less than twice as long as broad, very flat, almost circular when viewed from above. Third joint of antennæ large, flat, circular.

12. **Hagenius.**

First legs as distant from each other at base as are the second legs. Abdomen at least twice as long as broad.

Middle third of front margin of median lobe of labium produced in a very short rounded lobe with pavement teeth and a comb of flat scales.

13. **Ophiogomphus.**

Middle third of the same straight, or nearly so.....14. **Gomphus.**

*Subfamily Cordulegasterinæ.*—Antennæ 7-jointed; all tarsi 3-jointed; labium spoon-shaped, covering labrum and frons when closed, teeth on the opposed margin of the lateral lobes long, interlocking when closed so as to form a distinctly zigzag line of union. Abdomen two to three times as long as broad.

* Based on Cabot (50), Hagen (52, 53) and Garman "A Preliminary Report on the Animals of the Waters of the Mississippi Bottoms," etc. Springfield, Ill., State Printer, 1889.

Characters of the subfamily.. .....16. **Cordulegaster.**

*Subfamily Aeschninæ.*—Antennæ 6–7 jointed; tarsi 3-jointed; labium flat, not covering labrum or frons when closed.

Antennæ 6-jointed.

Head broader than long; a lateral spine on 4–9, middle and inferior appendages of equal length*.....17. **Epiæschna.**

Antennæ 7-jointed. Head broader than long.

Hind dorsal margin of 9 concave.

A lateral spine on 4–9, middle appendage sharply pointed.

18. **Fonscolombia.**†

A lateral spine on 5–9, middle appendage bifid at tip.

19. **Gomphæschna.**†

Hind dorsal margin of 9 straight.

Eyes more prominent at the fore corner; labium at rest extending backwards to the second legs; a lateral spine on 4, 5 or 6–9. ♂ projection conical. ♀ valves reaching apex of 9.....20. **Aeschna.**

Eyes more prominent in the middle; labium at rest extending backwards beyond second legs: a lateral spine on 7–9; middle appendage notched at tip, laterals half as long. ♂ projection cut at tip. ♀ valves shorter than 9 .....21. **Anax.**

*Family Libellulidæ.*—Antennæ 7-jointed; tarsi 3-jointed; labium spoon-shaped, covering labrum and frons when closed. Some Libelluline nymphs closely resemble those of the Cordulegasterinæ (*q. v.*), but may be distinguished by the teeth on the opposed margin of the lateral labial lobes being so short as to form an almost straight line of union when closed. Characters for separating Corduline from Libelluline nymphs are as yet unknown, as the latter subfamily has not been monographed.‡

*Subfamily Cordulinæ:*

An erect pyramidal horn on the front of the head.

No dorsal hook on 10; lateral spines on 9 reaching as far as level of tips of appendages.....22. **Didymops.**

At least a small dorsal hook on 10; lateral spines on 9 much shorter than in *Didymops*.....23. **Macromia.**

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* A clerical error in Part I has caused some confusion in regard to the appendages of Anisopterous nymphs. For "lateral" should be read "inferior" on page 196, line 25, p. 198, line 5 from bottom, and p. 199, line 3 from top. The denial of the homology of the inferior appendages of the males of the Zygoptera and Anisoptera (p. 199) refers, of course, to imagos only. Of the five appendages which terminate the abdomen of older Anisopterous nymphs, two are ventral—the *inferiors*, one is mid-dorsal (the *middle*) and on either side of it is a *lateral*, corresponding to a superior appendage of the imago.

† The identification of these is as yet doubtful (Cabot).

‡ As this is going through the press Dr. Karsch has published a paper on "Die Insecten der Berlandschaft Adeli" (West Africa) (Berl. Ent. Zeit. xxxviii, pp. 1–226, July, 1893) in which he gives characters for the separation of Corduline from Libelluline nymphs (p. 42). These characters will not serve for American species, and his characters for those of the "Calopterygidæ" are only those of the legions Calopteryx and Libellago (?).

No erect pyramidal horn on the front of the head.

A tubercle on either side of the top of the head; 10 very short, a dorsal hook on 3-9, a sharp lateral spine on 8-9, those of 9 exceeding the appendages.....24. **Epicordulia.**

No such tubercles.

Lateral spines of 8 very short, of 9 long, sharp, divergent, much longer than the appendages..25. **Tetragoneuria** (group of *cynosura*).

Lateral spines of 8-9 flat, sharp, incurved; of 9 not longer than the appendages.....27. **Somatochlora** (group of *libera*).

*Subfamily Libellulinæ:*

Middle (dorsal) terminal appendage a little longer than the inferiors (ventrals), all spinous. Teeth on opposed margin of lateral labial lobes flat, not interlocking, 8 and 9 with a long, sharp, incurved lateral spine.....28. **Pantala.**

Middle (dorsal) terminal appendage shorter than the inferiors, laterals without spines. Teeth on opposed margin of labial lobes much shorter than in *Pantala*, interlocking in a nearly straight line; otherwise as in *Pantala*.....29. **Tramea.**

The nymphs of but a small proportion of the species are known, so that no attempt is made in this paper to define their specific characters.

## List and Characters of the Species.

[N. B.—The following explanations, in addition to those contained in the preface, are required for the proper understanding of the subsequent text. Much greater importance is attached to structural than to color differences; what are regarded as the important specific characters are indicated by *italics*. Although teneral colors (see p. 203) are often mentioned, the colors usually described are those of the adult insect, and allowance must be made for such age-differences in identifying specimens. The wings are to be understood as being colorless, unless otherwise stated. The abdominal segments are denoted by the numerals 1 to 10. Measurements are always expressed in millimetres, and the length of the abdomen always includes the terminal appendages. Names of collectors have usually been cited at the end of the list of localities for each species in such cases where their labors have extended the known areas of distribution beyond those already published by Hagen (37), de Selys, Banks (38) and others. Abbreviations employed are Sup. app., superior appendages. Inf. app. inferior appendages. Abd., abdomen. H. w., hind wing. Phila., Philadelphia. Del. Co., Pa., Delaware County, Pennsylvania. N. J., New Jersey. Twp., Township. A. E. S., W. I., C., collections of the American Entomological Society, Wagner Free Institute of Science and of P. P. Calvert, respectively.]

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### Subfamily 1. CALOPTERYGINÆ.

#### 1. **Calopteryx** Leach.

(*Calepteryx*) Leach, Edinb. Encyc. ix. p. 137, 1815. Amer. Edit. viii, pt. ii. p. 726, 1816. Selys, Mon. Calopt. p. 22, 1854.

**1. Calopteryx maculata** Beauv.

*Agrion m.* Beauvois, Ins. Afr. Amer. p. 85, Neur. pl. 7, fig. 3, 1805. *C. m.* Hagen, Psyche v. p. 249, 1889.

Metallic blue or green; labium, two lateral thoracic stripes, pectus, venter of 1–7 or 8, black. Hind margin of wings decidedly convex.

♂. Wings *velvety black* (gray or brown—teneral), no pterostigma. Venter of 8–10 whitish. Sup. app. with outer margin denticulated, apical half wider, bent inwards and downwards, apex obtuse. Inf. app. one-fourth shorter, extreme apex acute, bent inwards.

♀. Wings smoky, apical fourth sometimes darker; *pterostigma* white, of 6-12 cells; veins metallic; 8 or 9–10 with a mid-dorsal longitudinal line and a spot each side, whitish or yellowish.

Abd. ♂ 34–40, ♀ 30–41.5. Hind w. ♂ 27–27.5, ♀ 29–34.5.

Common around Phila., along the banks of narrow streams, May 24—Aug. 17; ovipositing June 28, July 6.

Quebec—Florida, west to Kansas and Texas.

**2. Calopteryx dimidiata** Burm. race **apicalis** Burm.

*C. a.* Burmeister, Handb. Ent. ii, p. 827, 1839. Hagen, Psyche v, p. 246, 1889.

Metallic green or blue; labium, head below, thoracic sutures, feet, abdominal venter, black. *A sharp tubercle* on each side of rear of head. Wings narrow hind and front margins parallel for a part of their length.

♂. Wings with *apical sixth black*, its inner border straight; no pterostigma. Sup. app. similar to *maculata*.

♀. Wings hyaline; *pterostigma* absent, or very small and white, of 2–3 cells.

Abd. ♂ 35–37, ♀ 31–32. H. w. ♂ 27, ♀ 29.

Phila., 2 ♂ 1 ♀ (Burmeister), 1 ♂, 1 ♀ (Uhler)—Hag. *l. c.*

Massachusetts, New York, Delaware (Beutenmüller, A. E. S.)

2. **Hetærina** Hagen.

Hagen, Syn. Calopt. p. 30, 1853. Selys, Mon. Calopt. p. 96, 1854.

**3. Hetærina americana** Fabr.

*Agrion a.* Fabricius, Ent. Syst. Supp. p. 287, 1798. *H. a.* Walsh, Proc. Ent. Soc. Phila. ii, pp. 211, 267, 1863. *Agrion basalis* Say, Harris Ins. Inj. Veg. (Flint's edit.) pl. 1, fig. 2, 1862.

Head and thorax coppery red (♂) or metallic green (♀), or these sometimes reversed. Thorax with a humeral and two lateral stripes, pectus, yellow. Abdomen metallic green, an interrupted, basal, yellow ring on 3–7. *Tips* of wings *unspotted; pterostigma very small, yellow. Tibiæ superiorly pale.*

♂ ♂. Basal fifth or sixth (except at front border of front wings) bright red, sometimes replaced by reddish brown on hind wings. *Sup. app.* forcipated, inner margin near middle with two tubercles, of which the more basal is the larger, whose sides are convergent (the apical side longer) whose tip is obtusely rounded, and whose surface bears no smaller tubercles; the other (distal) tubercle has the basal side longer, its tip rounded; apex of sup. app. obtuse. Inf. app. reaching first tubercle of superiors, nearly straight, narrowing to the truncated apex.

♀. Base and front margin of wings pale yellowish brown. Mid-dorsal thoracic carina sometimes yellow; 1–10 with a narrow, interrupted, mid-dorsal, yellow line.

Abd. ♂ 34–37, ♀ 31. Hind w. ♂ 25–30, ♀ 28.

Crum and Ridley Creeks, Del. Co., Pa., and elsewhere near Phila., Aug. 11—Sept. 23.

Maine to Maryland, west to Wisconsin and Missouri.

**4. Hetærina tricolor** Burm.

*Calopteryx t.* Burmeister, Handb. Ent. ii, p. 827, 1839. *H. t.* Selys, Mon. Calopt. p. 136, pl. 12, fig. 5, 1854.

Blackish brown. Thorax with a humeral and two lateral stripes, pectus, yellow. *Tibiæ black.*

♂. *Extreme tips* of all the wings *brown;* basal sixth of front wings, except on front margin, bright red, with *no* adjoining brown; basal fifth of hind wings brown. *Pterostigma black. Sup. app.* longer than 10, forcipated, inner edge with a basal tubercle and a median dilatation, whose edge is straight or convex, and which ends abruptly, nearly at right angles. Inf. app. half as long, straight, apices upcurved.

♀ (not seen by the writer). Wings not spotted, base somewhat yellowish. *Pterostigma yellow.*

Abd. ♂ 40–42, ♀ 37. Hind w. ♂ 29–30, ♀ 31.

Philadelphia—Hagen (37).

Pennsylvania, Georgia, Texas (A. E. S.).

Subfamily 2. AGRIONINÆ.

3. **Lestes** Leach.

Leach, Edinb. Encyc. ix, p. 137, 1815. Amer. Edit. viii, pt. II, p. 726, 1816. Selys, Bull. Ac. Belg. (2) xiii, p 295, 1862.

*A.* ♂. *Inf. app. not longer than half the sup. app.*

**Lestes eurina** Say (Pl. III, fig. 14).

*L. e.* Say, Journ. Ac. Phila. viii, p. 36, 1839. Walsh, Proc. Ac. Phila., 1862, p. 385. Scudder, Psyche vi, p. 66, 1891.

*Dark metallic green;* lips pale green, blue, or yellow; mid-dorsal carina and humeral suture black, sides yellow inferiorly, with a variable blackish spot or band on the second lateral suture. *Wings pale yellowish.*

♂. *Sup. app.* on inner side with an acute basal tooth and a truncate median tooth, whose edge is denticulated; apices somewhat thickened. *Inf. app.* one-third as long, straight, apex blunt, not dilated.

♀. Mid-dorsal thoracic carina yellow.

Abd. ♂ 35.5–41, ♀ 34. Hind w. ♂ 25–29, ♀ 28.

Massachusetts (Say, Babcock—A. E. S., C.), Illinois (Walsh).

Dobb's Ferry, N. Y., July 7, 10, 23, by G. D. W. Williamson (C.).

**Lestes congener** Hagen (Pl. III, fig. 15).

*L. c.* Hagen, Syn. Neur. N. A., p. 67, 1861. Selys, Bull. Ac. Belg. (2) xiii, p. 316, 1862.

*Blackish brown;* lips, sides of thorax inferiorly, usually a narrow humeral stripe, sometimes rear of head and mid-dorsal carina—yellow. Two oblique black marks behind third coxæ; a black line on second lateral suture.

♂. *Sup. app.* on inner side with a short, acute, basal tooth, followed by a small,

straight dilatation, somewhat denticulated, ending by an obtuse angle. *Inf. app.* reaching to the middle of the dilatation, with apices curved inwards and upwards, blunt, not dilated.

♀. Abdomen with a narrow, yellow, mid-dorsal line.

Abd. ♂ 28–29, ♀ 25–27. Hind w. ♂ 18.5–21, ♀ 20–22.

New York, Delaware, Yellowstone, Colorado, Nevada (Hillman).

*B.* ♂. *Inf. app. longer than half of, but not longer than, sup. app. Rear of the head* (♂ ♀) *blackish.*

*a.* ♂. *Inf. app. s-shaped.* ♀ *with a yellow band from eye to eye across rear of head.*

**Lestes unguiculata** Hagen (Pl. III, fig. 16).

*L. u.* Hagen, Syn. Neur. N. A., p. 70, 1861. Selys, Bull. Ac. Belg. (2) xiii, p. 299, 1862.

Blackish brown; lips, mid-dorsal thoracic carina, a humeral stripe (usually narrower in ♂ than ♀), and the sides inferiorly, yellow. Frequently a broad oblique, blackish band near second lateral suture. Abdom. dorsum metallic brown or green, 3–7 with an interrupted, basal, yellow ring. Pterostigma brown, the vein at each end white.

♂. Sup. app. on inner side with a *short, acute, basal tooth,* followed by a *dilatation whose edge is first convex, then concave,* and more or less denticulated. Inf. app. *somewhat s-shaped,* curving from base to apex, outwards, inwards and outwards. Much of adult ♂ pruinose. Teneral males also show the postcephalic band of the ♀.

♀. Humeral stripe wider below.

Abd. ♂ 25–31.5, ♀ 22.5–31.5. Hind w. ♂ 17–21.5, ♀ 17.5–25.

♂ ♀, Pennsylvania, June 16, by S. F. Aaron (A. E. S., C.).

Quebec to Pennsylvania, and across the continent to California. (Sheraton, J. P. Moore, Hitchings, Harvey, Truman, Cheney, Hillman,—A. E. S., C.)

*b,* ♂. *Inf. app. straight, or nearly so.* ♀ *with no yellow postcephalic band.*

**Lestes uncata** Kirby (Pl. III, fig. 18).

*L. u.* Kirby, Cat. Odon. p. 160, 1890. *L. forcipata* Hagen, Syn. Neur. N. A., p. 71, 1861. *L. hamata* Selys, Bull. Ac. Belg. (2) xiii, p. 300, 1862.

*Metallic green.* Lips, a humeral stripe (occasional in ♂) and sides of thorax inferiorly, yellow.

♂. Sup. app. on inner side with *two acute teeth,* edge between them denticulated. Inf. app. reaching as far as the second tooth, *almost straight, apices widened on the inner side.*

♀. Mid dorsal thoracic carina yellow; humeral stripe *uniformly narrow.*

Abd. ♂ 26–32, ♀ 23 5–29. H. w. ♂ 19–22, ♀ 19–24.

Nova Scotia, Maine, New Hampshire, Massachusetts, District of Columbia, Georgia, Ontario, Illinois, Wisconsin, South Dakota, California (Miss Wadsworth, Mrs. Slosson, Sheraton, Calvert—A. E. S., C., Mich. Agric. College).

**Lestes disjuncta** Selys (Pl. III, fig. 19).

*L. d.* Selys Bull. Ac. Belg. (2) xiii, p. 302. 1862.

*Blackish brown.* Lips, sometimes mid-dorsal thoracic carina, a humeral stripe and sides of thorax inferiorly, yellow or pale green. 3–6 with an interrupted, transverse, basal, yellow ring.

♂. Sup. app. on inner side with *two acute nearly equal teeth*, edge between them denticulated. Inf. app. exceeding the second tooth, almost straight, *apices not widened.* Old ♂ with an oblique black band on second lateral suture, prothorax, base and apex of abdomen pruinose.

♀. Humeral stripe wider than in ♂, somewhat wider below.

Abd. ♂ 27–30.5, ♀ 26–29. H. w. ♂ 18–20, ♀ 20–21.5.

Nova Scotia, Maine, New Hampshire, New York, Illinois, Colorado, Yellowstone (Mrs. Slosson, J. P. Moore, Calvert—A. E. S., C.).

**5. Lestes forcipata** Rambur (Pl. III, fig. 20).

*L. f.* Rambur, Nevr. p. 246, 1842. Selys, Bull. Ac. Belg. (2) xiii, p. 303, 1862. *L. hamata* Hagen, Syn. Neur. N. A., p. 70, 1861.

*Blackish brown.* Lips, mid-dorsal thoracic carina, humeral stripe (broader below) and sides of thorax inferiorly, yellow.

♂. Sup. app. on inner side with *two teeth, basal one larger, acute*, edge between straight, denticulated. Inf. app. exceeding second tooth, almost straight, *apices a little dilated.* Old ♂ with an oblique black band on second lateral suture, or with sides of thorax, base and apex of abdomen pruinose.

♀. Humeral stripe *distinctly wider* below.

Abd. ♂ 30–35, ♀ 28–34. H. w. ♂ 19–24, ♀ 22–25.

Hind wing reaching to hind end of 6th abd. seg. (♂ or to middle of 7th ♀).

Ridley Twp., Del. Co., Pa., May 30—July 31; transforming July 21. One ♂, N. J., May 8; 2 ♂ 1 ♀ Pa. May 19–27 (A. E. S.).

Massachusetts to Florida, Wisconsin, Illinois, Texas, Colorado (Hitchings, Richardson—A. E. S., C.).

**6. Lestes rectangularis** Say (Pl. III, fig. 21).

*L. r.* Say, Journ. Ac. Phila. viii, p. 34, 1839. Selys, Bull. Ac. Belg. (2) xiii, p. 306, 1862.

*Blackish brown.* Lips, mid-dorsal thoracic carina, humeral stripe (wider below), sides of thorax inferiorly green or yellow. ♀ sometimes with a dorsal pruinose spot.

♂. Sup. app. on inner side with *two acute teeth, basal one shorter and less acute*, edge between denticulated. Inf. app. reaching or exceeding the second tooth, almost straight, *apices bent down, not dilated.*

♀. Humeral stripe *wider below.* De Selys *l. c.*, says that the ♀ *rectangularis* may be distinguished from the other species by the genital valves not being denticulated on the free edge, but this is very doubtful.

Abd. ♂ 33–42, ♀ 31–32.5. H. w. ♂ 18.5—22, ♀ 22–23.5.

Hind wing reaching to hind end of 5th abd. seg. (♂ or to middle of 6th ♀).

Small streams around Phila., July 14—Sept. 14.

Maine to Georgia, west to Minnesota (Miss Wadsworth, Mrs. Slosson, Jones, Calvert—A. E. S., C., Mich. Ag. Coll.).

**Lestes vigilax** Selys (Pl. III, fig. 17).

*L. v.* Selys, Bull. Ac. Belg. (2) xiii, p. 306, 1862.

♂. *Metallic green.* Lips blue or yellow. Thorax with mid-dorsal carina, a narrow humeral stripe and sides inferiorly, yellow. Posterior abdominal segments blackish. Sup. app. on inner side with a *basal, moderately acute tooth followed by two round tubercles.* Inf. app. *very slender*, exceeding the second tubercle, *apices not dilated.* Old ♂ with rear of head, sides of thorax, 9–10, pruinose.

♀. Unknown.

Abd. ♂ 34.5–38. H. w. ♂ 21–25.

One ♂, Pa. (A. E. S.) Morris Co., New Jersey, July 10, by C. W. Johnson (W. I., C.). Massachusetts (Hitchings).

*C.* ♂. *Inf. app. longer than sup. app. Rear of the head* (♂ ♀) *yellow.*

**7. Lestes inequalis** Walsh (Pl. III, fig. 24).

*L. i.* Walsh, Proc. Ac. Phila. 1862, p. 385.

*Metallic green.* Lips pale brown or blue. Mid-dorsal thoracic carina and a humeral line yellow or black. Sides of thorax inferiorly yellow.

♂. Sup. app. on inner side with an *acute basal tooth, followed by a somewhat convex denticulated edge, and a rather flat, rounded tubercle.* Inf. app. *a little longer, very slender*, straight, apices curved upwards and inwards, *not dilated.*

♀. Humeral stripe wider below, 9 sometimes with two dorsal yellow spots. Old ♀ with rear of head, 9–10, pruinose.

Abd. ♂ 36–42, ♀ 35–40. H. w. ♂ 25–26.5, ♀ 25–27.

Ditches, Tinicum Is., Pa., June 24, July 22, by P. P. Calvert (C.); not abundant.

Maine, New Hampshire, New Jersey, Illinois (Harvey, Mrs. Slosson, C. W. Johnson).

### 4. **Argia** Rambur.

Rambur, Névr. p. 254, 1842. Selys, Bull. Ac. Belg. (2) xx, p. 382, 1865.

*A. More than one cell lying immediately beneath the pterostigma.*

**8. Argia putrida** Hagen.

*Agrion p.* Hagen, Syn. Neur. N. A., p. 96, 1861. *Argia p.* Selys, Bull. Ac. Belg. (2) xx, p. 385, 1865.

Rear of the head *blackish.*

♂. Head and thorax clay-colored. Thorax with a mid-dorsal band, a humeral line and a post-humeral stripe confluent below, and a line on the second lateral suture, black. Abdomen black, a pale, transverse, basal ring on 3–7; sometimes a pale dorsal spot on 9. Old ♂ mostly pruinose. Hind margin of 10 excised, sides of excision thickened, elevated and produced backwards as a small process on either side overhanging, but shorter than, the sup. app. Sup. app. one-third as long as 10, blunt. Inf. app. two to three times thicker, obtuse, usually longer, apex entire.

♀. Head and thorax pale green. Thorax with mid-dorsal carina, sometimes the lateral sutures, or even a mid-dorsal band, black. Abdomen green, an interrupted black stripe each side.

Abd. ♂ 30–37, ♀ 29–37. H. w. ♂ 23–26.5, ♀ 24–28.5.

Near Phila., June 24, 30, by S. F. Aaron (A. E. S.); abundant; in copula June 30. Little Crum Creek, Ridley Twp., Del. Co., Pa., July 6, by P. P. Calvert (C).

Quebec to Florida; Texas, Illinois, Wisconsin (Provancher, Miss Wadsworth, Harvey, Hitchings, Mrs. Slosson, Johnson—A. E. S., C.)

*B. Only one cell lying immediately beneath the pterostigma.*

*a. Pale colors predominating on thoracic dorsum.*

**9. Argia violacea** Hagen.

*Agrion v.* Hagen, Syn. Neur. N. A., p. 90, 1861. *Argia v.* Selys, Bull. Ac. Belg. (2) xx, p. 404, 1865.

Rear of the head *yellowish*. Pterostigma *brown*. Thorax with a mid-dorsal and a *humeral stripe*, and a line on second lateral suture, black. Vertex black.

♂. Violet, including post-ocular spots; two apical spots on 2–6, and the most of 7, black; 8–10 *blue*. Hind margin of 10 excised as in *putrida*. Sup. app. one-third as long as 10, blunt. Inf. app. twice as long and as thick, directed upwards; extreme apex *slightly notched* in profile.

♀. Brown, or brownish green; a black stripe each side of 2–9, widest on 7.

Abd. ♂ 23–29. ♀ 24–27. H. w. ♂ 18–21, ♀ 20–22.

Common around Phila., June 6—Sept. 10; in copula or ovipositing July 6, 9, 11, 21, Sept. 10.

Maine to Virginia; Illinois, Texas (Bullock et al.).

**10. Argia tibialis** Rambur.

*Platycnemis t.* Ramb. Nèvr., p. 241, 1842. *A. t.* Selys, Bull. Ac. Belg. (2) xx, p. 413, 1865. *Agrion fontium* Hagen, Syn. Neur. N. A., p. 91, 1861.

Rear of head *black*. Pterostigma *blackish*. Thorax with a mid-dorsal and a broad *humeral stripe*, and a line on second lateral suture black. Vertex black.

♂. Lilac or blue. Postocular spots and sides of thorax blue or yellow. Abdomen black, 3–7 with a transverse basal yellow ring; 9–10 *blue*. Hind margin of 10 excised. Sup. app. one-third as long as 10, *apex excised from side to side*, inner branch thickest. Inf. app. longer, thicker, directed upwards; *apex bifid*, upper branch longer and thicker.

♀. Blue or reddish; similar to ♂, 3–7 with a transverse basal ring and an incomplete mid-dorsal line, yellow; 9 black, 10 yellow.

Abd. ♂ 26–29, ♀ 26–29. H. w. ♂ 19.5–22, ♀ 21–23.

One ♂ Beatty's Mills, Crum Creek, Del. Co., Pa., June 28, 1888, by P. P. Calvert (C). Six ♂, New Jersey, July 4 (A. E. S.)

Pennsylvania to Florida; Texas, Illinois.

**11. Argia apicalis** Say.

*Agrion a.* Journ. Ac. Phila. viii, p. 40, 1839. *Argia a.* Selys, Bull. Ac. Belg. (2) xx, p. 414, 1865.

Rear of head *yellowish*. Pterostigma brown. Thorax with mid-dorsal carina and an *inferior humeral spot*, black. Vertex black.

♂. Pale blue; 2–6 with a black stripe each side, 7 black, with a pale transverse basal ring, 8–10 *blue*. Hind margin of 10 excised, edges of excision much swol-

len. Sup. app. one-third as long as 10, with *a small inferior tooth.* Inf. app. much thicker, twice longer, directed upwards; apex bifid, branches of *equal* length, upper branch thicker.

♀. Ochre-brown replacing blue of ♂; 8–9 or 10 with a black stripe each side; inferior humeral spot often small or wanting.

Abd. ♂ 26–30, ♀ 26–29.5. H. w. ♂ 20–23, ♀ 20–23.5.

Morton, ponds near Primos, Del. Co., Pa., June 24—Sept. 10. Fairmount Park, Phila., by P. Laurent. District of Columbia, Virginia, Illinois, Texas (A. E. S., C.).

*b. Black predominating on thoracic dorsum.*

12. **Argia bipunctulata** Hagen.

*Agrion b.* Hagen, Syn. Neur. N. A., p. 90, 1861. *Argia b.* Selys, Bull. Ac. Belg. (2) xx, p. 415, 1865.

Rear of head mostly pale. Pterostigma reddish brown. Thorax with a very wide mid-dorsal and a *wide humeral stripe,* and a line on second lateral suture, black. Vertex black.

♂. Blue; a basal spot on 1, 2–6 at apex, 7, except at base, black. Hind margin of 10 excised. Sup. app. one-third as long as 10, cylindrical. Inf. app. longer, thicker, apex excised, *lower branch thicker. A pale blue bifid tubercle between sup. app.*

♀. Yellow replacing blue of ♂; 6, and even 4 and 5, like 7. 9–10 black.

Abd. ♂ 20–22, ♀ 20–22. H. w. ♂ 14.5–16, ♀ 15–17.

Atco and Berlin, N. J., July 12, 17, by P. Nell and P. P. Calvert (C.). Three ♂ 1 ♀ Pa. (A. E. S.)

Georgia, Florida.

5. **Erythromma** Charpentier.

Charp. Lib. Ent. p. 20, 1840. Selys, Bull. Ac. Belg. (2) xli, p. 1300, 1876.

**Erythromma? conditum** Hagen.

*E.? c.* Hagen, Bull. Ac. Belg. (2) xli, p. 1305, 1876.

Blue or yellow, the following black: nasus, vertex, head behind and beneath, a broad mid-dorsal thoracic band wider above and with irregular margins, and a mark under each wing-base.

♂. Prothorax with hind margin entire, rounded. Ab. seg. 1 with a basal spot, dorsum of 2–7 (except at base) and of 10, black. Sup. app. *as long as* 10, apex dilated and curved inwards. Inf. app. a little shorter, straight.

♀. Prothorax with hind margin five-lobed, mid-dorsal lobe largest. Dorsum of 1–10 black, of 10 cleft to base.

Abd. ♂ 28–29.5, ♀ 27–29.5. H. w. ♂ 20–22.5, ♀ 22–23.

Maine (Miss Wadsworth), Maryland, District of Columbia.

6. **Nehalennia** Selys.

Selys, Rev. Odon. d'Eur. p. 172, 1850; Bull. Ac. Belg. (2) xli, 1235, 1876.

**13. Nehalennia irene** Hagen.

*Agrion i.* Hagen, Neur. N. A., p. 74, 1861. *N. i.* Selys, *l. c.*, p. 1240, 1876.

Metallic green. Frons, lips, sides of thorax inferiorly, pale blue, green or yellow. *No postocular spots,* but a yellow occipital line. 3–6 with an interrupted transverse, basal, blue or yellow ring.

♂. Hind margin of prothorax entire, either side straight, convergent at a wide angle to the middle, which is rounded. An apical spot on 8, greater part of 9, 10 almost entirely, blue. Hind margin of 10 *excised in the middle and denticulated.* Sup. app. excessively short, bifid, lower branch shorter. Inf. app. *longer*, with three apical tubercles.

♀. Hind margin of prothorax tri-lobed, middle lobe smallest. An apical spot on 9, apex of 10, blue.

Abd. ♂ 20–23, ♀ 20–22.5. H. w. ♂ 13–15.5, ♀ 14–15.

One ♂, Pa. (A. E. S.). One ♂, Berlin, N. J., July 17, by P. P. Calvert (C.).

Maine to Pennsylvania, west to South Dakota; Florida (Mrs. Slosson, Cheney, Truman et al).

**14. Nehalennia posita** Hagen.

*Agrion p.* Hagen, Syn. Neur. N. A., p. 77, 1861. *N. p.* Selys, Bull. Ac. Belg. (2) xli, p. 1242, 1876.

Metallic black, but frequently with a dark blue or dark green tinge. The following light green, yellow or blue: frons, lips; *a small, round, postocular spot* each side; *a short antehumeral stripe with a spot above it, the two forming a ! mark;* sides of thorax; an interrupted transverse basal ring on 3–7. *A black line* on second lateral suture.

♂. Hind margin of prothorax entire, rounded. Sometimes a blue dorsal spot on 10, hind margin with *an elevated bifid process*, similar to that of males of *Ischnura*. Sup. app. one-half as long as 10, directed downwards, with a small supero-external tooth. Inf. app. slightly shorter.

♀. Hind margin of prothorax produced slightly in the middle. Antehumeral stripe and spot above it often united. 10 sometimes blue. Thorax and abdomen pruinose in old ♀ ♀.

Abd. ♂ 16.5–23, ♀ 18.5–22. H. w. ♂ 10–14, ♀ 13.5–16.

Very common around Phila., May 1—Oct. 2.

Quebec, Massachusetts, New Jersey, Pennsylvania, District of Columbia, Georgia, Florida (Provancher, Skinner—A. E. S., C.)

7. **Amphiagrion** Selys.

Selys, Bull. Ac. Belg. (2) xli, p. 284, 1876.

**15. Amphiagrion saucium** Burmeister.

*Agrion s., Ag. discolor* Burm. Handb. Ent. ii, p. 819, 1839. *Amph. s.* Selys *l. c.*, p. 285, 1876.

Head dark brown or black, yellowish behind. Thoracic dorsum brown (♂) or reddish (♀), sides yellow. Pterostigma brown, upper, outer angle very acute, costal side longer than lower side.

♂. Abdomen bright red, frequently the extreme apical margin of 3–6, greater apical part of 7, 8–10, black, sutures red: occasionally 7–10 red with black spots each side. Sup. app. one-half as long as 10, simple, slender, directed downwards. Inf. app. longer, curved slightly upwards.

♀. Abdomen red, black near apex of 3–6, 7–9 black, 10 reddish.

Abd. ♂ 17–22.5, ♀ 20–23. H. w. ♂ 13.5–15.5, ♀ 14–17.5.

Small streams around Phila., May 14—July 14; fairly common; ovipositing June 3, 9.

Quebec to South Carolina; Ontario, Illinois, South Dakota, Colorado (Provancher, Pettit, Truman, Beales).

8. **Enallagma** Charpentier.

Charp. Lib. Eur. p. 21, 1840. Selys. Bull. Ac. Belg. (2) xli, p. 496, 1876.

*A.* ♂—2 *with black on dorsum restricted to an apical spot, 8–9 blue.* ♀—2 *with a dorsal black band for its entire length.*

*a.* 4–5 *antenodal cells.*

**16. Enallagma durum** Hagen (Pl. III, fig. 32).

*Agrion d.* Hagen, Syn. Neur. N. A., p. 87, 1861. *E. d.* Selys, *l. c.* p. 500, 1876.

Cuneiform post-ocular spots usually united by a transverse line. Vertex, a broad mid-dorsal (but with the *carina blue or yellow*) thoracic and a humeral stripe, black.

♂. Blue with the following black: a basal spot on 1, wider than long; a rounded apical spot, with an apical "tail," on 2; apical part of 3–6, *pointed anteriorly;* 7, except a transverse basal ring; 10 dorsally. Sup. app. one-fourth to one-third as long as 10, broad, excavated within, apex *truncated obliquely, inferior apical angle with a pale tubercle.* Inf. app. *a little longer*, apex acute, curved inwards.

♀. Yellowish red. Dorsum of 1–9 with a broad black band widened before the apices, an interrupted transverse basal yellow ring on 3–7. Dorsum of 10 mostly *yellowish or green.*

Abd. ♂ 26–32.5, ♀ 28–33. H. w. ♂ 18–22.5, ♀ 21–24.5.

Two ♀, Fort Mifflin, Phila., Aug. 31, 1891, by P. P. Calvert (C.).

Quebec, Rhode Island, New Jersey, Maryland, Virginia, Florida, Louisiana (Provancher, Johnson—A. E. S., C.).

*b.* 3 *antenodal cells.* ♀ *with dorsum of* 10 *black.*

**17. Enallagma civile** Hagen (Pl. III, fig. 31).

*Agrion c.* Hagen, Syn. Neur. N. A., p. 88, 1861. *E. c.* Selys, Bull. Ac. Belg. (2) xli, p. 514, 1876.

Cuneiform postocular spots usually connected by a transverse line. Vertex, a broad mid-dorsal thoracic and a humeral stripe, black.

♂. Blue, the following black: a square basal spot on 1; a rounded apical spot, with or without an apical "tail," on 2; apical part of 3–6; 7, except a transverse basal ring; 10 dorsally. Sup. app. shorter than 10, compressed, *broadly bifid at apex*, upper branch longer, *with a pale tubercle between the branches.* Inf. app. *a little shorter*, apex acute, curved upwards.

♀. Green or reddish yellow. Mid-dorsal thoracic carina sometimes green. Dorsum of 1–10 *black*, widened before apices, 3–7 with an interrupted, transverse, basal pale ring.

Abd. ♂ 22–28.5, ♀ 24.5–30. H. w. ♂ 15–20, ♀ 18–21.

Near Phila. May 26–27 (A. E. S.). Wayne, June 29, and Ridley Twp., Del. Co., Pa., Aug. 31—Sept. 10, by P. P. Calvert (C.). In coitu May 26, June 29, Sept. 7.

Quebec to Virginia, west to South Dakota; California, New Mexico, Texas, Mexico, Cuba, Porto Rico (Provancher, J. P. Moore, Truman, Cockerell, Kolbe).

*Note.*—Specimens collected by the writer at Saratoga Lake, N. Y., Aug. 15, 1889, have, in the males, the apical half to two-thirds of 3-6 black, the two branches of the sup. app. of nearly equal length, and, in the females, the post-ocular spots circular, unconnected. The writer believes them to be merely a variety of *civile*, and Dr. Hagen agreed with this opinion.—*Civile* often has the postcostal cross-vein as nearly under the first antecubital as in *E. durum*.

**Enallagma Hageni** Walsh (Pl. III, figs. 22, 23).

*Agrion H.* Walsh, Proc. Ent. Soc. Phila. ii, p. 234, 1863 (Proc. Ac. Phila., 1862, p. 386). *E. H.* Selys, Bull. Ac. Belg. (2) xli, p. 512, 1876.

Circular or cuneiform post-ocular spots not connected. Vertex, a mid-dorsal thoracic and a humeral stripe, black.

♂. Blue or green, the following black: a basal spot wider than long on 1; a rounded apical spot, with or without an apical "tail," on 2; apical part of 3-6; 7, except a transverse basal ring; 10 dorsally. Sup. app. one-half as long as 10, *quadrangular, depressed*, apical angles rounded, an internal basal rounded tubercle. Inf. app. a little longer, slender, apices acute, curved inwards.

♀. Green or reddish yellow. Dorsum of 2-10 with a broad *black* band, a transverse basal yellow ring on 3-7.

Abd. ♂ 22-25, ♀ 20-24. H. w. ♂ 15-18.5, ♀ 16.5-18.

Quebec, Maine, Massachusetts, New Hampshire, Delaware, Maryland, Illinois, South Dakota, Wisconsin (Miss Wadsworth, Mrs. Slosson, Harvey, Owen, Truman, Cheney—A. E. S., C.).

**Enallagma aspersum** Hagen (Pl. III, fig. 30).

*Agrion e.* Hagen, Syn. Neur. N. A., p. 97, 1861. *E. a.* Selys, Bull. Ac. Belg. (2) xli, p. 518, 1876.

Cuneiform postocular spots *confluent with the blue or green of the rear of the head*. Vertex, a broad mid-dorsal thoracic and a humeral stripe, black.

♂. Blue, the following black: a basal quadrangular spot on 1; a rounded apical spot, with an apical "tail," on 2; at least the *apical half* of 3; 4-6, except an interrupted, transverse basal ring; *basal half to quarter* of 7; 10 dorsally. Sup. app. *as long as* 10, compressed, apex thickened, obtuse; *an inner inferior, subquadrangular, basal process*. Inf. app. reaching as far as end of this process, slender.

♀. Green; postocular spots sometimes separated from rear of head and then serrate on the edge. Dorsum of 1-10 with a broad *black* band, *reduced to a narrow stripe on greater basal part of* 7 *and* 8; a pale transverse basal ring on 3-6.

Abd. ♂ 24.5-27, ♀ 23.5-24. H. w. ♂ 17.5-20, ♀ 18.

Two ♂, Pa., June 10 (A. E. S.).

New Hampshire to Virginia; Illinois (Williamson, Skinner, Richardson, Babcock, Calvert).

*B.* ♂ ♀. *A dorsal black band on* 2 *for its entire length. Usually* 3 *antenodal cells.* ♀ *with dorsum of* 10 *blue, green, or yellow.*

**18. Enallagma divagans** Selys, (Pl. III, figs. 25, 26).

*E d.* Selys, Bull. Ac. Belg. (2) xli, p. 521, 1876.

Cuneiform postocular spots almost connected. Vertex, a mid-dorsal thoracic and a humeral stripe, black.

♂. Blue, dorsum of 1–7, 10, *black;* an interrupted transverse basal blue ring on 3–7. Sup. app. *shorter than* 10, *not bifid*, but with inner lower side produced (= lower branch of *exsulans*). Inf. app. *a little longer* than sup. app., apices curved inwards.

♀. Yellow or blue. *Mid-dorsal thoracic carina, and a stripe superimposed upon the humeral stripe* (so that the black thereof is reduced to a line on each side of the red), *reddish.* Dorsum of 1–8 dark metallic green or black; basal half of 9 with a dark spot, which is *bifid posteriorly.* 10 pale dorsally.

Abd. ♂ 19.5–24.5, ♀ 22–28. H. w. ♂ 14–17, ♀ 18–20.

One ♂ 1 ♀, Little Crum Creek, Ridley Twp., Del. Co., Pa., in company with *E. exsulans*, July 3, 1893, by P. P. Calvert (C.); 2 ♂, Pa., June 16, probably by S. F. Aaron (A. E. S.).

Massachusetts (Selys).

**19. Enallagma exsulans** Hagen (Pl. III, fig. 29).

*Agrion e.* Hagen, Syn. Neur. N. A., p. 82, 1861. *E. e.* Selys. Bull. Ac. Belg. (2) xli, p. 522, 1876.

Cuneiform postocular spots almost connected. Vertex, a mid-dorsal thoracic and a humeral stripe, black.

♂. Blue or green, dorsum of 1–8, 10, *black;* a transverse basal blue or yellow ring on 2–7. Sup. app. *shorter than* 10, *bifid*, upper branch half shorter than the lower. Inf. app. *as long as the upper branch*, directed upwards. Hind margin of 10 somewhat elevated and bifid, but not as much as in *Ischnura.*

♀. Yellow, lilac, blue or green. *Mid-dorsal thoracic carina and a stripe superimposed upon the humeral stripe* (so that the black thereof is reduced to a line on each side of the red), *reddish.* Dorsum of 1–9 dark metallic green or black, narrower at or absent on apex of 9 but *not bifid*, of 10 blue or green.

Abd. ♂ 24–30, ♀ 24.5–28.5. H. w. ♂ 16.5–19.5, ♀ 18–20.5.

Darby, Crum and Stone Creeks, Tinicum Is., Pa., June 6—Aug. 17; ovipositing June 28, July 6, 15.

Maine, New York to Virginia, Illinois, Texas (Miss Wadsworth, Calvert).

**20. Enallagma signatum** Hagen (Pl. III, fig. 28).

*Agrion s.* Hagen, Syn. Neur. N. A., p. 84, 1861. *E. s.* Bull. Ac. Belg. (2) xli, p. 525, 1876.

Cuneiform postocular spots connected. Vertex, a broad mid-dorsal thoracic and a humeral stripe, black or metallic brown.

♂. Blue or yellow. Dorsum of 1–8, 10, metallic brown or black; a transverse, basal blue or yellow ring on 3–7. Sup. app. *a little longer than* 10, compressed, superior margin *straight*, inferior margin very slightly divergent, apex obliquely

truncated from below upwards and backwards (distally), a small tooth at the inferior angle, extreme (upper) apex forming a small hook on the inner side. Inf. app. half shorter, slender, simple, curved inwards.

♀. Blue or yellow. Dorsum of 1–9 metallic brown, narrower at or absent on apex of 9, of 10 yellow: a transverse basal yellow ring on 3–7.

Abd. ♂ 26–30, ♀ 24–27.5. H. w. ♂ 16–18, ♀ 17–20.

Tinicum Is., Primos, Del. Co., Pa.; Fort Mifflin, Phila., etc., June 11—July 11, Aug. 31, by P. P. Calvert; ovipositing or in coitu June 17, July 5, 11.

Maine, Massachusetts, Maryland, Georgia, Louisiana, Illinois (Harvey, Hitchings).

**Enallagma pollutum** Hagen (Pl. III, fig. 27).

*Agrion p.* Hagen, Syn. Neur. N. A., p. 83, 1861. *E. p.* Selys, Bull. Ac. Belg. (2) xli, p. 527, 1876.

Very similar to *E. signatum*. ♂. Sup. app. hardly longer than 10, upper side *curved upwards*, lower side divergent, so that the height of the apex (profile view) is *twice* as great as at base; upper apical angle more prominent.

♀. Not as yet separable from that of *signatum*, as the characters suggested by de Selys—that *pollutum* has a black line on the second lateral suture which is wanting in *signatum*, and a difference in width in the dorsal abdominal band—are not constant.

Abd. ♂ 22.5–26.5, ♀ 22.5–23.5. H. w. ♂ 13.5–16.5, ♀ 15.5–16.

Maine (Harvey), Florida.

### 9. **Ischnura** Charpentier.

Charp. Lib. Eur. p. 20, 1840. Selys, Bull. Ac. Belg. (2) xli, p. 258, 1876. *Micronympha* Kirby, Cat. Odon. p. 140, 1890.

**21. Ischnura verticalis** Say.

*Agrion v.* Say, Journ. Ac. Phila., viii, p. 37, 1839. *A. v.*, *A. Ramburii* Hagen, Syn. Neur. N. A., p. 82, 76, 1861. *I. v.* Selys, *l. c.* p. 265, 1876.

♂. Black. Frons, lips, postocular spots, rear of head, a narrow antehumeral stripe (rarely interrupted at its middle), sides of thorax, blue or green. A black line below one or both wings. 3–7 with an interrupted basal yellow ring; 8–9 *blue with a black stripe each side*. Sup. app. one-fourth as long as 10, lamellate. Inf. app. a little longer, rather thick at base, outer lower side prolonged to form the acute apex, which is curved inwards, *not divided*. Pterostigma of front wings black, of hind wings yellowish brown.

*Black* ♀. Colored like ♂ (teneral), or greater part of body *pruinose*, a transverse, apical, black ring on 3–7, 8–10 *blackish*. Pterostigma of all the wings yellowish brown.

*Orange* ♀. Blue of head replaced by orange, postocular spots confluent with rear of head. Thoracic dorsum orange, a median band and *a humeral stripe*, black. 1, 2 *and base of* 3 *orange* on dorsum, remainder of abdomen black, 4–7 with an interrupted basal ring. Pterostigma yellowish brown on all the wings.

Abd. ♂ 19.5–22.5, Bl. ♀ 17.5–23.5, Or. ♀ 18.5–22.5. H. w. ♂ 11.5–14.5, Bl. ♀ 13.5–17, Or. ♀ 12.5–17.5.

Very common; streams and ponds around Phila., earlier than May 1—Oct. 16. Ovipositing May 1, 19, 30, June 22, 29, July, Aug. 31, Sept. 7.

Quebec to Georgia, west to Missouri and Louisiana.

**22. Ischnura Ramburii** Selys.

*Agrion R.* Selys, Rev. Odon. d'Eur. p. 186, 1850; *I. R.* Bull. Ac. Belg. (2) xli, p. 272, 1876. *Agrion iners, tuberculatum, credulum* Hagen, Syn. Neur. N. A., p. 75, 76, 80, 1861.

♂. Black. Frons, lips, postocular spots, rear of head, a narrow antehumeral stripe, sides of thorax, blue or green. A black line on the second lateral suture. 3–6 with an interrupted, transverse basal yellow ring; 8 *blue*. Sup. app. one-third as long as 10, apex bifid, inner branch bent down to form an inferior process. Inf. app. a little longer, thick at base, apex slender, *not divided*, curved inwards. Pterostigma of front wings black in the centre, of hind wings yellowish brown.

*Black* ♀. Colored like the ♂. Pterostigma of all the wings yellowish brown.

*Orange* ♀. Blue or green of head replaced by orange, postocular spots confluent with the rear of the head. Thoracic dorsum orange (sometimes olive), a broad median black band, but *no humeral stripe*. 1 *and base of* 2 *orange*, remainder of abdomen black, an interrupted, transverse, basal, yellow ring on 3–7. Pterostigma of all the wings yellowish brown.

Abd. ♂ 21–28. Bl. ♀ 22.5–27, Or. ♀ 22–27. H. w ♂ 13–17, Bl. ♀ 15–19, Or. ♀ 15.5–18.

Tinicum Is., Crum Creek, Pa., Aug. 23—Sept. 4.

Quebec, Ontario, New York to Florida; Louisiana, Texas, Mexico, West Indies, Venezuela, Peru (Provancher, Pettit, Johnson,). This species replaces *I. verticalis*, to a great extent, on the sea-shore.

10. **Anomalagrion** Selys.

Selys in Sagra's Hist. Cuba, Ins. p. 469, 1857; Bull. Ac. Belg. (2) xli, p. 254, 1876.

**23. Anomalagrion hastatum** Say.

*Agrion h.* Say, Journ. Ac. Phila. viii, p. 38, 1839. *Anom. h.* Selys, *l. c.* p. 255, 1876.

♂. Orange or yellow. The following dark metallic green, blue, or purple: vertex, nasus, a broad mid-dorsal thoracic and a wide humeral stripe, a mark at second lateral suture and very variable markings on base and apex of 1–7. Sup. app. half as long as 10, bifid, inner branch longer, bent downwards. Inf. app. a little longer, apex slender, curved inwards. Pterostigma on front wings *reddish, not touching the costa;* on hind wings *black, normal.*

*Black* ♀ (not seen by the writer). Head and thorax as in ♂, abdomen black, 3–6 with an interrupted, transverse, basal, yellow ring. Pterostigma normal, yellowish brown (Selys).

*Orange* ♀. Postocular spots confluent with orange of rear of the head. Thoracic dorsum orange, with a broad median metallic green stripe; sometimes a

black humeral line; sides yellow. Abdomen *orange*, 5 or 6–8 or 9 dark metallic green, 9 with a black mark each side at base. Pterostigma of all the wings normal, yellowish.

Abd. ♂ 18–22, Or. ♀ 18–21. H. w. ♂ 10–12, Or. ♀ 12–15.

Ridley Twp., Del. Co., Pa., May 17—Aug. 9, Sept. 24–25.

Maine to Florida; Indiana, Louisiana, Texas, Cuba, Hayti, Venezuela.

Subfamily 3. GOMPHINÆ.

11. **Tachopteryx** Selys.

Selys, Bull. Ac. Belg. (2) vii, p. 551, 1859.

**Tachopteryx Thoreyi** Hagen.

*Uropetala T.* Hagen, Mon. Gomph. p. 373, pl. 19, fig. 3, 1858. *T. T.* Selys, *l. c.* xlvi, p. 696, 1878.

Olive or pale lilac. Face yellowish, the following black: a transverse band on nasus, a transverse basal stripe on frons superiorly, thoracic sutures, a humeral band enclosing a yellow spot, a band on second lateral suture and on lateral metathoracic carina, two spots each side on 2, apical half of and a dorsal band on 3–7, most of 8–10. Triangle of hind wings of *two* cells. Pterostigma very long (8–9.5 mm) and narrow.

♂. Sup. app. longer than 10, flattened, twice as wide at two-thirds of length as at base, apex obtuse, a small submedian inferior tubercle. Inf. app. one-fifth shorter, broad, *an acute, superior, submedian, recurved tooth* each side, apex prolonged at each side to form an acute process, which is curved upwards and outwards.

♀ (not seen by the writer). Vulvar laminæ reaching base of app.

Abd. ♂ 54–58, ♀ 54–55. H. w. ♂ 51, ♀ 51–53.

Massachusetts, New York, Maryland, North Carolina (A. E. S.), Kentucky.

12. **Hagenius** Selys.

Selys, Bull. Ac. Brux. xxi, pt. 2, p. 82, 1854. Mon. Gomph. p. 238, 1858.

**Hagenius brevistylus** Selys.

*H. b.* Selys, *ll. cc.* p. 82, 1854; p. 241, pl. 13, fig. 2, 1858.

Black. The following yellow: face (except basal band on frons above and sutures), labrum, mid-dorsal thoracic carina, one or two narrow antehumeral stripes, a transverse anterior stripe, two broad lateral bands and a line between them on thorax, a dorsal stripe on 1 to base of 8, sides of 1–10.

♂ (not seen by the writer). Occiput moderate, hind border convex. Sup. app. a little shorter than 10, stout, curved slightly inwards, three inferior teeth, apex acute, curved downwards to form a hook. Inf. app. of equal length, quadrangular, broader than long, apex upcurved.

♀. Occiput small, upper surface concave, hind border hardly concave, on each side a small, posterior, rounded tubercle. Vulvar lamina not as long as half of 9, nearly quadrangular, somewhat narrower at apex, apical margin concave, or even bifid for one-third the length of the lamina.

Abd. ♂ 54–56, ♀ 54.5–63. H. w. ♂ 47–50, ♀ 50–55.

Maine, Massachusetts, New York, Ontario, Wisconsin, Kansas, Texas, Fla., Kentucky, Maryland (Miss Wadsworth, Mrs. Slosson).

### 13. **Ophiogomphus** Selys.

Selys, Bull. Ac. Brux. xxi, pt. 2, p. 39, 1854. C. R. Soc. Ent. Belg. xxii, p. lxiv, 1879.

**Ophiogomphus rupinsuleusis** Walsh.

*Herpetogomphus r.* Walsh, Proc. Ac. Phila. 1862, p. 388. *O. r.* Selys, Bull. Ac. Belg. (2) xlvi, p. 434, 1878.

Greenish yellow. Thorax with a humeral stripe, frequently an antehumeral stripe, and a line on second lateral suture, brown. Abdomen brown, an elongated dorsal yellow spot, pointed posteriorly, on 1–8 or 10.

♂. Sup. app. a little longer than 10, robust, *apex obtuse*, apical half denticulated below. Inf. app. *not as wide* as divergence of sup. app., its branches *truncated* to form the acuter angle at inner side, space between branches *half as wide* as either branch.

♀. Occiput with *a short yellow spine* each side. Vulvar lamina almost as long as 9, triangular, bifid in more than its apical half, the branches contiguous, but their *extreme tips divergent*.

Abd. ♂ 35–38, ♀ 35–38. H. w. ♂ 28–33.5, ♀ 32.

Quebec, Maine, New York, New Jersey, Pennsylvania, Ontario, Illinois, Wisconsin (Provancher, C. W. Johnson, A. E. S.).

### 14. **Gomphus** Leach.

Leach, Edinb. Encyc. ix, p. 137, 1815; Amer. ed. (Phila.) viii, pt. ii, p. 726, 1816. Selys, Mon. Gomph. p. 115, 1858.

*A. Abdominal segments 7–9 not greatly dilated (i. e. not 3–4 times as wide as 4).*

*a. Dorsum of 10 mostly black. Occiput not denticulated behind.*

**Gomphus nævius** Hagen.

*G. n.* Hagen, Bull. Ac. Belg. (2) xlvi, p. 462, 1878.

♀. Greenish yellow. The following black: suture between frons and nasus, base of labrum, frons above at base, vertex, occiput. *No spines* on vertex. Hind margin of occiput slightly concave. Blackish brown predominating on thoracic dorsum so as to leave a transverse anterior, an isolated antehumeral and a humeral stripe, yellowish; sides greenish with three brown stripes. Abdomen black; 3–9 with a transverse basal ring, sometimes medially interrupted, 2, 3 and 8 with a mid-dorsal spot—yellow. App. white or yellow. Vulvar lamina *one-fifth* as long as 9, *apical half* bilobed, tips rounded.

♂. Unknown.

♀. Abd. 25, h. w. 21.

Maine (Harvey), York and Berks Cos., Pa. (Hagen *l. c.*)

**Gomphus parvulus** Selys.

*G. p.* Selys, Bull. Ac. Brux. xxi, pt. 2, p. 56, 1854; (2) xlvi, p. 459, 1878; Mon. Gomph. p. 157, 1858.

Black predominating, the following yellow: a transverse stripe on frons above, on nasus and on labrum; on thorax a transverse, medially-interrupted anterior,

a narrow antehumeral, a humeral and three lateral stripes; 1–8 with a dorsal spot or line and sides of 1–4. Costa black. App. blackish.

♂. Sup. app. straight, cylindrical, apex becoming *gradually acute, no teeth or spines.* Inf. app. less than half as long.

♀ (not seen by the writer). *No spines on vertex.* Hind margin of occiput almost straight. Vulvar lamina *half* as long as 9, *almost completely divided* into two oval divergent lobes.

Abd. ♂ ♀ 28. H. w. ♂ ♀ 26.

Nova Scotia to New Hampshire, Berks and York Cos., Pa.

**24. Gomphus abbreviatus** Hagen.

*G. a.* Hagen, Bull. Ac. Belg. (2) xlvi, p. 464, 1878.

Yellow, including *most of labium.* Vertex black. *No black stripe* on suture between frons and nasus. Dark brown predominating over yellow on thoracic dorsum and forming two confluent submedian dorsal stripes, an antehumeral and a humeral, confluent, a line in front of the metastigma and on the second lateral suture. Abdomen black, a mid-dorsal and a lateral basal yellow spot on 1–6 or 8, sides of 8 and 9 yellow. Costa black. Pterostigma yellow to reddish brown.

♂. Hind margin of occiput convex. Sup. app. with apex acute and an *inferior spine-like tooth* at two-thirds their length. Inf. app. shorter.

♀. A spine on each side of vertex. Hind margin of occiput almost straight. Vulvar lamina *one-third* as long as 9, triangular, *apical half* bifid, the halves contiguous.

Abd. ♂ 26–33, ♀ 28–29. H. w. ♂ 22–25, ♀ 25–25.5.

One male, Phila. (A. E. S.), probably belongs to this species.

Maine, Massachusetts.

*b. Dorsum of* 10 *mostly yellowish or reddish. No spines on vertex of female.*

**25. Gomphus exilis** Selys (Pl. II, fig. 11).

*G. e.* Selys, Bull. Ac. Brux. xxi, pt. 2, p. 55, 1854; (2) xxxv, p. 748, 1873.

Pale green. Vertex brown. Hind margin of occiput *nearly straight.* Brown predominating on thorax and forming two median dorsal stripes, widening downwards, an antehumeral and a humeral stripe barely separated by a pale line, and most of the sides, leaving two oblique, lateral, green bands, one behind the humeral, the other behind the second lateral suture. Abdomen blackish brown, 1–10 with a basal dorsal green spot or band.

♂. Sup. app. with an inferior tooth-like *process* at two-fifths their length, the apical side of the process *sloping gradually* to apex of app.

♀. Vulvar lamina short, *not longer than one-fifth* of 9, bilobed, lobes not contiguous, *as long as or a little longer than wide.* tips roundly pointed.

Abd. ♂ 29–30.5, ♀ 28.5–30. H. w. ♂ 23–24, ♀ 24–25.5.

The most common Gomphine around Phila., May 26—July 4.

Quebec, Maine, Massachusetts, New Jersey, Pennsylvania, Maryland, Florida (Miss Wadsworth, Skinner, Laurent).

**26. Gomphus minutus** Rambur.

*G. m.* Ramb., Ins. Nevr., p. 161, 1842. Selys, Mon. Gomph., p. 155, pl. 9, fig. 3, 1858.

Pale green or yellow. Vertex brown. Hind margin of occiput *decidedly convex*. Brown predominating on thorax. Thorax and abdomen similar to *exilis* in coloring. A character upon which stress was originally laid by de Selys—that the sides of the thorax were mostly yellowish, with two brown bands—is not constant.

♂ (not seen by the writer). Sup. app. with a strong, acute, submedian, inferior *tooth*.

♀. Vulvar lamina *very short*, hardly bilobed, lobes *much wider than long*.

Abd. ♂ 35, ♀ 35–37. H. w. ♂ 28, ♀ 30–32.

One female, Phila., July 1, S. F. Aaron (A. E. S.). One female, Phila., June 22, 1893, C. W. Johnson (C.).

Pennsylvania, Georgia.

**27. Gomphus plagiatus** Selys.

*G. p.* Selys, Bull. Ac. Brux. xxi, pt. 2, p. 57, 1854; (2) xlvi, p. 465, 1878.

Olive-green. *Brown* predominating on thoracic dorsum so as to leave a narrow antehumeral stripe, *notably divergent from above downwards from its fellow of the opposite side*, and the mid-dorsal carina yellow (teneral) or green; sides pale, a line in front of the metastigma and on the second lateral suture, brown. Abdomen *long*, 1–6 brown with a pale green mid-dorsal spot or stripe, 7–10 *yellowish*.

♂. Hind margin of occiput slightly convex. Sup. app. without teeth, apex *obliquely truncated* (when viewed from above), the acuter angle on the inner side, usually no tubercle at the outer (obtuse) angle. Inf. app. one-fourth shorter.

♀. Hind margin of occiput straight. Vulvar lamina *very short, less than one-tenth* of 9, emarginated in the middle, tips on either side of emargination acute.

Abd. ♂ 40–45, ♀ 44–49. H. w. ♂ 32–35, ♀ 35.5–37.

One ♂ one ♀, Fairmount Park, P. Laurent, C. W. Johnson; one ♂ one ♀, Phila., P. Nell; one ♂, Folsom, Del. Co., Pa., July 17, 1886, P. P. Calvert (C.).

Pennsylvania, Maryland, South Carolina, Tennessee, Florida, Texas (A. E. S.).

**28. Gomphus villosipes** Selys.

*G. v.* Selys, Bull. Ac. Brux. xxi, pt. 2, p. 53, 1854; (2) xlvi, p. 457, 1878.

Yellowish green. Hind margin of occiput with *a median conical tubercle. Green* predominating on the thorax, but with the following brown: a submedian, an antehumeral and a longitudinally-divided humeral stripe, and sometimes some lines on the sides. Abdomen dark brown, 1–7 with a mid-dorsal yellowish green spot or stripe, 10 yellowish

♂. Sup. app. *without teeth*, apex *obliquely truncated* when viewed from above, the acuter angle on the inner side and prolonged into a spine, which is bent somewhat inwards, *a rounded tubercle* at the outer (obtuse) angle. Legs *mostly black*.

♀. Vulvar lamina *hardly one-third* as long as 9, triangular, bifid in its *apical third*, the halves contiguous.

Abd. ♂ 37–39, ♀ 38. H. w. ♂ 30–33, ♀ 33.5.

Ditches at Tinicum Is., woods at Folsom, ponds at Primos, Del. Co., Pa., June 7—July 5, P. P. Calvert; not abundant (C., A. E. S.).

Massachusetts, Michigan.

*B. Abdominal segments 7–9 greatly dilated (i. e. 3–4 times wider than 4).*

**29. Gomphus vastus** Walsh.

*G. v.* Walsh, Proc. Ac. Phila. 1862, p. 391.

Frons and nasus greenish yellow, basal superior half of the former and a broad band at suture between them, *black*. Labrum margined with black. Thorax yellow and dark brown, the latter predominating dorsally and forming two confluent, median, dorsal bands widening below, a broader antehumeral, a narrower humeral stripe, a line in front of the metastigma and one on the second lateral suture. Abdomen black, a mid-dorsal yellow spot or line on 1–7 or 8, 8 and 9 with a large lateral, yellow spot, 9 and 10 *unspotted dorsally*. Wings slightly yellowish at base.

♂. Sup. app. with acute apex and an *extremely small, externo-inferior, antapical spine*.

♀. Vertex sometimes with a spine each side. Vulvar lamina *slightly more than half* as long as 9, rather narrow, *apical sixth* bifid, tips acute.

Abd. ♂ 37, ♀ 35–37. H. w. ♂ 29–31, ♀ 31–32.

One male flew in a shop at Sixth and Chestnut Sts., Phila., May 28, 1891; P. Nell (A. E. S.).

Quebec (Provancher), New York, District of Columbia, Illinois.

15. **Dromogomphus** Selys.

Selys, Bull. Ac. Brux. xxi, pt. 2, p. 58, 1854.

**30. Dromogomphus spinosus** Selys.

*D. s.* Selys, *l. c.* p. 59, 1854. *Gomphus s.* Selys, Mon. Gomph. p. 120, pl. 7, fig. 2, 1858.

Face, lips, occiput yellowish or green, vertex black. At most a very narrow black line between frons and nasus. Thoracic dorsum maroon-brown; mid-dorsal carina, anterior border (these two confluent), an *isolated* submedian stripe, an *isolated* antehumeral line, and the sides, yellow or green. Abdomen blackish, a dorsal maculate yellow band on 1–10. Wings sometimes faintly yellowish at base.

♂. Hind margin of occiput convex, no tubercle. Sup. app. divergent, an *obtuse inferior median thickening*, apex acute, upturned.

♀. Vertex with *an erect spine* behind each lateral ocellus. Occiput with a *median pointed tubercle*. Vulvar lamina *one-third* as long as 9, its *apical half* bifid, branches slightly divergent, tips acute.

Abd. ♂ 39–41.5, ♀ 41.5–45. H. w. ♂ 32–34.5, ♀ 35–39.

Fairmount Park and elsewhere in Phila., June 10, 26, S. F. Aaron, P. Laurent, P. Nell; not common (A. E. S., C.).

Maine, Massachusetts, New Jersey, Pennsylvania (York, etc.), Georgia, Florida, Kentucky, Illinois (Miss Wadsworth, Hitchings, G. Miller, Babcock.—W. I.).

Subfamily 4. CORDULEGASTERINÆ.

16. **Cordulegaster** Leach.

Leach, Edinb. Encyc. ix, p. 136, 1815; Amer. ed. (Phila.) viii, pt. ii, p. 725, 1816. Selys, Mon. Gomph, p. 328, 1858. *Thecaphora* Selys, *l. c.* p. 319.

**Cordulegaster maculatus** Selys.

*C. m.* Selys, Bull. Ac. Brux. xxi, pt. 2, p. 105, 1854; (2) xlvi, p. 689, 1878.

Blackish brown; the following yellow: *rear of head. frons* (except a very narrow basal black band above), nasus, labrum (except an anterior brown border and mid-basal spot), a cuneiform antehumeral stripe, wider above, two oblique, lateral, thoracic bands and an intermediate line, two pairs (median and apical) of spots on 2–5 and sometimes 8, one pair on 6–9.

♂. Sup. app. shorter than 10, straight, two strong inferior teeth, one basal, the other submedian. Inf. app. one-third shorter, *tip nearly as wide as base.* Spines of anterior row on second and third tibiæ replaced by knobs.

♀. Vulvar laminæ long, projecting considerably beyond 10.

Abd. ♂ 47.5–53, ♀ (incl. vulv. lam.) 55.5–60.5. H. w. ♂ 37–41, ♀ 43–45.

Nova Scotia, New England, Ontario, Maryland, Georgia.

**Cordulegaster erroneus** Hagen.

*C. e.* Hagen, Bull. Ac. Belg. (2) xlvi, p. 688, 1878.

Blackish brown. *Frons* yellow above, black anteriorly. Labrum yellow, entirely margined and almost crossed with black. *Rear of head black.* The following yellow: nasus, labium, occiput, a cuneiform antehumeral stripe, wider above and divergent from above downwards, two broad, oblique, lateral, thoracic stripes, two pairs of spots on 2–4, one pair on 5–8, anterior pair on 2–4 larger, meeting (or almost so) on dorsal carina, so also the pair on 5–7.

♂. Sup. app. a little shorter than 10, two small inferior teeth, one basal, the other submedian. Inf. app. one-fourth shorter, tip *half as wide as base.* Spines of anterior row of second and third tibiæ replaced by knobs.

♀ (not seen by the writer). Vulvar laminæ long, projecting beyond 10.

Abd. ♂ 53–56, ♀ 64. H. w. ♂ 44–47, ♀ 51.

Pocono Mts., Pike Co., Pa., August, E. M. Aaron (A. E. S.); North Carolina, Kentucky.

Subfamily 5. AESCHNINÆ.

17. **Epiæschna** Selys.

Selys, Proc. Bost. Soc. Nat. Hist. xviii, p. 36, 1875. Karsch, Ent. Nach. xvii, p. 290, 1891.

**31. Epiæschna heros** Fabricius.

*Aeschna h.* Fabr., Ent. Syst. Suppl. p. 285, 1798, Hagen, Syn. Neur. N. A., p. 128, 1861.

Face brown and green. Frons above with a black T-spot. Thorax brown; an antehumeral stripe wider above, two bands on the sides, and inter-alar spots—green. Abdomen dark brown marked with blue or green spots and lines. Wings smoky or yellowish to a varying extent, extreme apex sometimes darker. Pterostigma orange to reddish brown. Membranule white. App. as long as, or longer than 9 + 10.

♂. Rear of head simple. 10 with a mid-dorsal tooth. Sup. app. with apical two-thirds wider, an inferior tubercle near base, apical half with a superior, longitudinal carina and the inner edge hairy, apex truncated. Inf. app. one-half shorter, oblong, apex notched.

♀. Rear of head produced on either side of the occiput in an obtuse angle, which projects beyond the latter. 10 with a ventral, plate-like *denticulated* projection. App. oblanceolate.

Abd. ♂ 61–71, ♀ 64–72. H. w. ♂ 53–60, ♀ 58–62.5.

Fairly common around Phila., May to September.

Quebec to Mexico, west to the Mississippi.

### 18. **Fonscolombia** Selys.

Selys, Bull. Ac. Belg. (3) v, p. 736, 1883. Karsch, Ent. Nach. xvii, p. 289, 1891.

**32. Fonscolombia vinosa** Say.

*Aeshna v.* Say, Jour. Ac. Phila., viii, p. 13, 1839. *Ae. quadriguttata* Burm. Hagen, Syn. Neur. N. A., p. 130, 1861.

Face greenish or brownish, lips yellow. Frons above with a brown spot. Thorax brown, an indistinct pale green, antehumeral stripe, sides with *two round bright yellow spots*. Abdomen constricted at 3, spotted with yellow. Wings with reddish veins, a small basal reddish brown or smoky spot, tips sometimes clouded. Pterostigma yellow, 4–5.5 mm. long. Triangle of 4–6 cells; at least *one* basal subcostal cross-vein.

♂. Sup. app. as long as 9 + 10, wider in apical two-thirds, apex hardly acute, a small inferior tooth near base. Inf. app. one-third as long, triangular, apex notched.

♀. A small brown spot at nodus.

Abd. ♂ 44–51, ♀ 48.5–59. H. w. ♂ 40–42, ♀ 41–44.

One male, Phila., Aug. 26; one female, Mt. Holly, N. J., July 4, S. F. Aaron (A. E. S.). One male, Fairmount Park, Aug. 29, 1891, P. Nell. One female, Clementon, N. J., S. F. Gross (C.).

Canada; Eastern United States; Fort Townson, Arkansas (Uhler's coll.).

### 19. **Gomphæschna** Selys.

Selys, Trans. Ent. Soc. Lond., 1871, p. 413. Karsch, Ent. Nach. xv, p. 238, 1889.

**33. Gomphæschna furcillata** Say, var **antilope** Hagen.

*G. a.* Hagen, Proc. Bost. Soc. N. H., xvi, p. 354, 1874.

Face yellowish brown. Frons above with a black T-spot. Thorax brown, an antehumeral green stripe; sides yellowish or brown, two median oblique black bands confluent above and below the metastigma. Abdomen dark brown, marked with blue or green spots. Pterostigma yellow to blackish brown.

♂. Sup. app. slender, *almost straight*, widened in their apical half, a small inferior tooth near base, apex rounded. Inf. app. less than half as long, apical half bifid, appendage narrowed a little at level of base of bifurcation, branches moderately divergent. Anal triangle of 1-2 cells; 4-6 postcubitals on front wings.

♀. A *brownish yellow cloud* around nodus; front wings with 9-13 antecubitals.

Abd. ♂ 42-44, ♀ 40. H. w. ♂ 34-36, ♀ 36.

One male, Clementon, N. J., S. F. Gross (C.).

New Jersey, Maryland, Virginia (T. R. Peale, C. W. Johnson—A. E. S., C., W. I.).

N. B.—This was originally described as a distinct species from *furcillata* Say, the chief differences being that the latter had the ♂ sup. app. curved inwards and downwards, apex of inf. app. more widely emarginated, 7 (*antilope* 4) postcubitals on front wings; ♀ wings unspotted 12-13 antecubitals on front wings (*antilope* 9-10), abdomen of slightly different shape. As additional specimens are examined, the differences between the two forms become less and less.

### 20. **Aeschna** Fabricius.

(*Aeshna*) Fabr., Syst. Ent. p. 424, 1775. Karsch, Ent. Nach. xvii, p. 288, 1891.

*A. Male with anal triangle of 2 cells, 10 with 3 basal dorsal teeth, of which the middle one is largest* (the specific characters of the females have not yet been determined).

**31. Aeschna juncea** Linné, var. **verticalis** Hagen.

*Ae. v.* Hagen, Syn. Neur. N. A., p. 122, 1861.

Face green, frons above with a black T-spot, *no black line on fronto-nasal suture*. Thorax dark brown, an antehumeral (wider above) and sometimes a short humeral stripe, green; two green or blue lateral bands. Abdomen dark brown, marked with blue or green spots and lines; 10 with a blue spot each side of dorsum. Membranule smoky.

♂. Abdomen constricted at 3. Sup. app. as long as 9 + 10, oblong, narrower at base, margins *entire*, a superior longitudinal carina *not denticulated*, apex moderately acute. Inf. app. half as long, triangular.

♀. App. oblong, narrower at base, apex rounded.

Abd. ♂. 50-53.5, ♀ 51-55. H. w. ♂ 42-45.5, ♀ 45-46.

Ridley Twp., Del. Co., Pa., Oct. 4–18, P. P. Calvert.

Nova Scotia to the District of Columbia, Illinois.

N. B.—No constant differences are apparent between this insect and the circumpolar *Ae. juncea* L., except that the latter has a black line on the fronto-nasal suture, and perhaps a slightly longer pterostigma, and the apex of sup. app. ♂ not quite so acute.

**Aeschna clepsydra** Say.

*Ae. c.* Say, Jour. Ac. Phila. viii, p. 12, 1839. Hagen, Neur. N. A., p. 122, 1861. *Ae. crenata* Hagen, Stet. Ent. Zeit. xvii, p. 369. *Ae. eremita* Scudder, Proc. Bost. Soc. N. H., x, p. 215, 1866.*

* The evidence on which this synonymy is based will shortly be published elsewhere.

Face greenish or luteous, frons above with a black T-spot, with or without a black line on fronto-nasal suture. Thorax dark brown, an antehumeral stripe, two lateral bands and sometimes an intermediate line, blue or green. Abdomen dark brown, marked with blue or green spots and lines; 10 with a blue spot each side of dorsum, sometimes confluent.

♂. Abdomen constricted at 3. Sup. app. as long as 9 + 10, oblong, narrower at base, margins *entire*, a superior longitudinal carina bearing 4–9 *denticles*, apex varying from rounded with extreme tip barely pointed to being prolonged into a distinct acute process which is directed somewhat downwards. Inf. app. half as long or longer, triangular.

♀. App. oblong, narrower at base, apex rounded.

Abd. ♂ 51–57.5, ♀ 50–53. H. w. ♂ 43–50, ♀ 42–46.5.

Labrador to Massachusetts, Maryland, New York, Illinois, Michigan, Wisconsin, Dakota, Saskatchewan, Irkutsk and Wilui River (Siberia), Finland (Sheraton, Brown, Dr. Mark, etc.—C., A. E. S.).

*B. Male with anal triangle of 3 cells, no dorsal teeth on* 10.

**35. Aeschna constricta** Say.

*Ae. c.* Say, Jour. Ac. Phila., viii, p. 11, 1839. Scudder, Proc. Bost. Soc. N. H., x, p. 212, 1866.

Face green or brown, frons above with a black T-spot, sometimes a black line on fronto-nasal suture. Thorax dark brown, an antehumeral green stripe, wider above, and two lateral, green, blue or yellow stripes. Abdomen dark brown, marked with green or blue spots and lines; 10 spotted or unspotted. Membranule blackish, basal half whitish.

♂. Abdomen much constricted at 3. Sup. app. as long as 9 + 10, widened in their apical half, *emarginate on the inner edge* in front of the apex, the emargination *quite hairy* and thickened to form a tubercle at its hind end (the hairs are sometimes matted together to give the appearance of an acute tooth pointed forwards); apex with a *long, acute, inferior, slightly anteapical spine.* Inf. app. half shorter, triangular.

♀. App. oblong, narrower at base, apex rounded. Wings sometimes yellowish.

Abd. ♂ 51.5–57.5, ♀ 51–55. H. w. ♂ 42–48, ♀ 42–48.

Common around Phila., Aug. 28—Oct. 16.

Labrador to Maryland, west to Colorado; Southern California to British Columbia; Kamtschatka, Siberia (A. E. S., C.).

21. **Anax** Leach.

Leach, Edinb. Encyc. ix, p. 137, 1815; Amer. ed. (Phila.) viii, pt. 2, p. 726, 1816. Karsch. Ent. Nach. xvii, p. 287, 1891.

**36. Anax junius** Drury.

*Libellula j.* Drury, Ill. Exot. Ent. I, p. 112, pl. 47, fig. 5, 1770. *A. j.* Hagen, Psyche v, p. 305, 1890.

Head and thorax bright green. Frons above with *a round black spot, surrounded by yellow, the latter encircled by a dark blue ring.* 1 and base of 2 green, 3–10 blue (♂), purple or lilac (♀), with a partly interrupted, mid-dorsal, brown band. Wings often pale yellowish to a varying extent.

♂. Hind margin of occiput slightly concave. Sup. app. *abruptly narrowed on inner side* just before the apex, which is rather truncated and prolonged on the outer side into *a sharp spine*. Inf. app. one-sixth as long, quadrangular, *wider than long*, upper surface with a submedian tooth and many smaller apical teeth each side.

♀. Hind margin of occiput elevated and emarginated in the middle.

Abd. ♂ 53.5-56, ♀ 52-56. H. w. ♂ 46.5-56, ♀ 48-56.

Common around Phila., earlier than May 1—Oct. 16; in copula or ovipositing May 1, June 15, 19, 22, 28, July 6.

Quebec to Florida, west to the Pacific, Alaska to Costa Rica, W. Indies, Sandwich Is., Kamtschatka, China.

**Anax longipes** Hagen, recorded from Brazil, West Indies, Mexico, Florida, Maryland, Massachusetts, has the frons green, *unspotted superiorly*, in both sexes.

Subfamily 6. CORDULINÆ.

22. **Didymops** Rambur.

Ramb., Ins. Nevr. p. 142, 1842. Selys, Bull. Ac. Belg. (2) xlv, p. 211, 1878.

**37. Didymops transversa** Say.

*Libellula t.* Say, Jour. Ac. Phila. viii, p. 19, 1839. *Macromia t.* Selys, Bull. Ac. Belg. (2) xxxi, p. 548, 1871.

Grayish to brown. Nasus and frons above yellow, the latter with *a superior black* T-*spot*. Thorax with a small antehumeral spot (sometimes absent), an oblique, mid-lateral band, and the antealar sinuses, pale yellow or white; *no* humeral stripe. Abdomen quite slender in the middle, thickened at 7–10, 2-8 with a spot each side of dorsum and 10 entirely, yellow. A small yellow or brown basal cloud at base of front margin of wings.

♂. Sup. app. longer than 10, denticulated below, extreme apex directed upwards and outwards. Inf. app. of equal length, broad, triangular.

♀. Vulvar lamina very short, emarginated in a semicircle.

Abd. ♂ 36–38, ♀ 38–40. H. w. ♂ 31–35, ♀ 38–39.

One male, Wissahickon, Phila., May 20, 1883, S. F. Aaron; one male, Fairmount Park, May 31, 1891, Dr. H. Skinner; one male, Mt. Holly, N. J., May 13, E. M. Aaron (A. E. S.). One male, Arcola, Montgomery Co., Pa., May 19, 1893, P. Nell (C.).

Quebec to Georgia; Michigan, Kentucky, Texas (Provancher, Miss Wadsworth, Harvey, Cabot).

23. **Macromia** Rambur.

Ramb. Ins. Nevr. p. 137, 1842. Selys, Bull. Ac. Belg. (2) xlv, p. 210, 1878.

**38. Macromia tæniolata** Rambur.

*M. t.* Ramb. *l. c.* p. 139, 1842. *Epophthalmia t.* Selys, *l. c.* (2) xxxi, p. 527, 1871.

Blackish, with more or less metallic reflection. Frons above metallic blue, with *two* small yellow spots in front of the vertex. The following yellow: a transverse nasal band, *a short antehumeral stripe*, a broad band entirely around

the thorax between the front and hind wings, an interrupted, transverse ring on 2, a triangular spot each side on 3–8, usually united and larger on 7.

♂ (not seen by the writer). 10 not elevated. Sup. app. a little longer than 10, a small median external tooth; apical half curved outwards, apex moderately acute. Inf. app. hardly shorter, apex truncated, upcurved.

♀. Vulvar lamina very short, hardly emarginate. Apical two-thirds of wings pale yellow.

Abd. ♂ 64, ♀ 63. H. w. ♂ 55, ♀ 57.

Philadelphia (Hagen 37, p. 57).

Pennsylvania, Maryland, Georgia, Florida (W. L.).

**39. Macromia illinoensis** Walsh.

*M. i.* Walsh, Proc. Ac. Phila., 1862, p. 397. Selys, Bull. Ac. Belg. (2) xxxi, p. 546, 1871. ? *Epophthalmia georgina* Selys, *l. c.* (2) xlv, p. 197, 1878.

Metallic blackish brown. Nasus yellowish, obscurely bordered with black. Frons above metallic blue, with *four* small yellow spots in front of the vertex. The following yellow: a broad band surrounding the thorax between the front and hind wings, a lateral spot and a middle transverse line on 2, a dorsal spot each side of 3–6, a broad, basal, dorsal spot on 7. Usually *no* antehumeral stripe. 1 or 2 posttriangular rows.

♂. Sometimes a dorsal yellow spot on 9. 10 not elevated. Sup. app. similar to those of *tæniolata*.

♀. Vulvar lamina short, less than one-sixth as long as 9, deeply bilobed at the middle. Wings with a dark brown basal spot between costa and subcosta to first antecubital.

Abd. ♂ 45–50.5, ♀ 49–53. H. w. ♂ 41–45, ♀ 45–49.

One male, Fairmount Park, Phila., P. Laurent (C.); one male, Pennsylvania (A. E. S.).

Quebec to Massachusetts; Pennsylvania, Illinois, Tennessee (*illinoensis*); Georgia, Illinois (H. L. Walker) (*georgina*).

N. B.—The absence or presence of cross-veins in the triangles, by which de Selys has separated *Macromia* from *Epophthalmia*, is not a constant character. It remains to be seen whether *georgina* and *illinoensis* are otherwise distinct, and whether both are variations of *tæniolata*.

24. **Epicordulia** Selys.

Selys, Bull. Ac. Belg. (2) xxxi, p. 259, 1871; xlv, p. 207, 1878.

**40. Epicordulia princeps** Hagen.

*Epitheca p.* Hagen, Syn. Neur. N. A., p. 134, 1861. *Cordulia p.* Selys, *l. c.* (2) xxxi, p. 275, 1871.

Olive- or yellowish brown. Abdomen swollen at base, yellowish, a mid-dorsal brown band on 3–10, interrupted by a transverse, yellow ring at each articulation. Wings with a basal, a nodal (this sometimes absent), and an apical spot of variable sizes, brown.

♂. Sup. app. nearly as long as 9 + 10, apical two-thirds dilated. Inf. app. one-third shorter, subtriangular.

♀. Vulvar lamina almost as long as 9, bilobed for its entire length. App. nearly one-and-a-half times as long as 9 + 10.

Abd. ♂ 42–45, ♀ 42–50. H. w. ♂ 40–41, ♀ 40–46.5.

Two males, June 14, July 1, Phila.; one male, Bristol, Pa., June 16; S. F. Aaron (A. E. S.).

Quebec to Connecticut; Pennsylvania, Maryland, Georgia, Michigan, Illinois, Texas (Provancher, Miss Wadsworth, Hitchings).

### 25. **Tetragoneuria** Hagen.

Hagen, Syn. Neur. N. A., p. 140, 1861. *Tetragoneura* Selys, Bull. Ac. Belg. (2) xlv, p. 207, 1878.

**41. Tetragoneuria cynosura** Say.

*Libellula c.* Say, Jour. Ac. Phila. viii, p. 30, 1839. *Cordulia c.* Selys, *l. c.* (2) xxxi, p. 270, 1871. *C. lateralis* Burm., Hagen, Syn. Neur. N. A., p. 139, 1861.

Blackish brown. Face and lips pale lilac or yellowish. Usually *no superior black* T *spot* on frons. Thorax clothed with white hairs, a yellow spot above and one below the metastigma. A yellow spot each side of dorsum of 2–9. Hind wings with a short, superior, dark brown, basal streak to first antecubital, and an inferior, triangular, basal spot not extending beyond the level of the median cross-vein; streak sometimes shorter and spot sometimes wanting.

♂. Sup. app. as long as 9 + 10, thickened in their apical half, *without teeth or spines.* Inf. app. one-third shorter.

♀. Vulvar lamina longer than 9, bifid almost to base, lobes divergent, somewhat bent towards each other in apical half. App. *shorter* than 9 + 10.

Abd. ♂ 28–30.5, ♀ 26–27. H. w. ♂ 28–29, ♀ 29–30.

One male, June 28, 1886; one male, June 4, 1887; one female, May 30, 1887; one female, June 6, 1892; edge of thickets, Folsom, Pa., P. P. Calvert (C.).

Quebec to Florida; Ohio, Illinois, Michigan, Louisiana.

**Tetragoneuria semiaquea** Burmeister.

*Libellula s.* Burm., Handb. Ent. ii, p. 858, 1839. *T. s.* Hagen, Syn. Neur. N. A., p. 140, 1861.

Very similar to *T. cynosura*, but the hind wings have the basal streak extending farther out, basal spot reaching beyond the triangle, or even to beyond the nodus. Probably only a variety of *cynosura*.

Abd. ♂ 24–28, ♀ 25–28.5. H. w. ♂ 25–28, ♀ 27.5–30.

Nova Scotia, Maine, Massachusetts; District of Columbia to Fla. (Miss Wadsworth, A. E. S.).

### 26. **Neurocordulia** Selys.

Selys, Bull. Ac. Belg. (2) xxxi, p. 278, 1871; xlv, p. 206, 1878.

**Neurocordulia obsoleta** Say.

*Libellula o.* Say, Jour. Ac. Phila., viii, p. 28, 1839. *Epitheca o.* Hagen, Psyche, v, p. 369, pl. i, figs. 7–9, 1890,

Dull olive-brown. Thorax with mid-dorsal carina, an anterior transverse stripe, and around the metastigma, yellow.

♂ (not seen by the writer). Dorsal apical margin of 10 slightly produced in the middle and *rounded*. Sup. app. thickened in apical half, *no angular notch* at middle of lower surface. Wings with a *yellowish* spot on each antecubital and near the arculus: on hind wings also an orange spot in the triangle.

♀. Vulvar lamina very short, with *a wide, median, rectangular notch*. Wings marked as in ♂, but spots larger, and also a spot at nodus and at base of front wings, and a basal band on hind wings from anal margin to postcostal vein leaving extreme base hyaline, brown.

Abd. ♂ 30, ♀ 32–36.5. H. w. ♂ 30, ♀ 31.5–38.

One female, Pennsylvania, May 28, 1881, G. H. Parker (A. E. S.). Massachusetts, Pennsylvania, Indiana, Illinois, Louisiana.

### 27. **Somatochlora** Selys.

Selys, Bull. Ac. Belg. (2) xxxi, p. 279, 1871; xlv, p. 204, 1878.

**42. Somatochlora lepida** Hagen.

*Cordulia l.* Hagen, *l. c.* (2) xxxi, p. 264, 1871.

Metallic green. Labium orange, a yellow spot each side of frons. Abdomen *not* widened before apex. All discoidal triangles *free*, internal triangle of front wings usually of 2 cells, wanting on hind wings. Base of wings sometimes pale yellow. Membranule with basal half white, apical half cinereous.

♂. Sup. app. longer than 10, slender at base, thickened beyond, a *very small inferior basal tubercle*, apex hardly acute. Inf. app. one-third shorter, subtriangular, apex quite narrow.

♀. Base of 1–2, *a spot each side of* 3–7, yellowish red. App. twice as long as 10. Vulvar lamina *a little less than half* as long as 9, *apical half bilobed*, apices rounded.

Abd. ♂ 26.5–29, ♀ 25–28. H. w. ♂ 26–28, ♀ 26–29.

One male, Atco, N. J., June 18, 1893, C. W. Johnson (C.). Maine to New Jersey, Maryland.

**Somatochlora linearis** Hagen.

*Cordulia l.* Hagen, Syn. Neur. N. A., p. 137, 1861. *Epitheca l.*, *E. procera* Selys, Bull. Ac. Belg. (2) xxxi, pp. 286, 285, 1871.

(Not seen by the writer.) Metallic green. Lips and face inferiorly brownish. Abdomen cylindrical, 2–8 with a yellow basal spot each side.

♂. Abdomen swollen at base. Sup. app. not as long as 9 + 10, arcuated at base, with *two external teeth*, one at one-third their length, the second, stronger, at two-thirds; *apex bifid*, external branch bent downwards. Inf. app. a little shorter.

♀. Vulvar lamina *a little longer* than 9, projecting almost at right angles from the abdomen, its margin *entire*.

Abd. ♂ 44–46, ♀ 42–52. H. w. ♂ 42–44, ♀ 40–51.

Pennsylvania, Georgia, Illinois, Missouri.

**Somatochlora filosa** Hagen.

*Cordulia f.* Hagen, Syn. Neur. N. A., p. 136, 1861. *Epitheca f.* Selys, Bull. Ac. Belg. (2) xxxi, p. 287, 1871.

Metallic green, blackish on hind part of abdomen. Labrum and clypeus brownish, labium yellowish. Thorax with two lateral yellow stripes, one beneath each pair of wings. Abdomen swollen and compressed at base, narrowed at 3, some yellow on the sides of 1–3.

♂. Sup. app. (4–4.5 mm.) longer than 9 + 10, cylindrical, curved slightly outwards then inwards in the basal fourth, thickened in the middle, apical fourth more slender and slightly divergent, apex terminating in *a very small hook* which is directed inwards and downwards, and is *compressed;* no teeth on sup. app. Inf. app. a little more than half as long, triangular, apex moderately acute, curved upwards but little.

♀ (not seen by the writer). App. 4 mm. long. *Vulvar lamina* forming a compressed trough, which is a little recurved and reaches to the tip of the abdomen.

Abd. ♂ 41, ♀ 48. H. w. ♂ 38–39, ♀ 43.

One male Petersburg, N. J., Aug. 30, 1892 (P. P. Calvert), Maryland, Georgia.

Subfamily 7. LIBELLULINÆ.

28. **Pantala** Hagen.

Hagen, Syn. Neur. N. A., p. 141, 1861. Kirby, Trans. Zool. Soc. Lond., xii, p. 265, 1889.

**43. Pantala flavescens** Fabricius.

*Libellula f.* Fabr., Ent. Syst. Supp. p. 285, 1798. *P. f.* Hagen, *l. c.* p. 142, 1861.

Yellowish. Abdomen with a maculate, mid-dorsal stripe, sometimes absent on 2–7, and a ventral stripe each side of 1–8, black. Apices of wings sometimes smoky; hind wings with anal margin yellowish, *no dark brown spot.*

Abd. ♂ 29–33, ♀ 32–34. H. w. ♂ 41–42, ♀ 39.5—41.

Two males, Fairmount Park, Phila., H. D. Coyle, park guard, through C. W. Johnson (C., W. I.). One female, Fairmount Park, Aug. 29, 1891, P. Nell (C.).

Massachusetts, Pennsylvania, Maryland, Virginia, Georgia, Fla., Wisconsin, Illinois, Missouri, Texas, Mexico, West Indies; Surinam to Northern Brazil; Fijis, New South Wales, Sumatra to Banca, Sandwich Is., Philippines, Kamtschatka to Ceylon, Egypt to Angola (Cabot, Uhler, Schafer, A. E. S.).

**44. Pantala hymenæa** Say.

*Libellula h.* Say, Jour. Ac. Phila. viii, p. 18, 1839. *P. h.* Hagen, Syn. Neur. N. A., p. 142, 1861.

Greenish, with dark brown markings. Hind wings with anal margin yellowish, and *a round dark brown anal spot* veined with yellow, apices sometimes smoky.

Abd. ♂ 30–32, ♀ 31–31.5. H. w. ♂ 39–42, ♀ 42.

One male, Fairmount Park, Phila., H. D. Coyle, park guard, through C. W. Johnson (C.).

Pennsylvania, Indiana, Illinois, South Dakota, Texas, N. Mexico, Mexico, Cuba (Truman, Cockerell).

29. **Tramea** Hagen.

Hagen, Syn. Neur. N. A., p. 143, 1861. Kirby, Trans. Zool. Soc. Lond. xii, p. 268, 1889.

**45. Tramea carolina** Linné.

*Libellula c.* Linné, Cent. Ins. p. 28, 1763. *T. c.* Hagen, *l. c.* p. 143, 1861.

Reddish brown; 8–10 with a broad, black, dorsal band. Extreme base of front wings yellowish; basal third of hind wings *brown* with yellow veins, a clear spot at middle of anal margin.

♂. Sup. app. *as long as* 9 + 10. Hamule *hardly if ever longer* than genital lobe.

♀. Vulvar lamina *not quite as long as* 9, bilobed in its apical three-fourths.

Abd. ♂ 31.5–34, ♀ 32–34.5. H. w. ♂ 41–44, ♀ 41–44.5.

Two males, May 26, June 10, Phila., S. F. and E. M. Aaron (A. E. S.).

Massachusetts to Florida. Brauer (Verh. z.-b. Gesell. Wien, xiv, p. 162) mentions one male of *T. carolina* from New Caledonia.

**46. Tramea lacerata** Hagen.

*T. l.* Hagen, Syn. Neur. Syn. N. A., p. 145, 1861.

Brownish black; 2–7 with a dorsal greenish spot. Extreme base of front wings dark brown; basal fourth or fifth of hind wings *violet-black*, whose outer margin is very ragged, a clear spot at middle of anal margin.

♂. Sup. app. *as long as* 8 + 9 + 10. Hamule *shorter* than genital lobe.

♀. Vulvar lamina *half as long as* 9, bilobed almost to base, apices of lobes emarginated.

Abd. ♂ 34–38, ♀ 35.5. H. w. ♂ 40–46, ♀ 46–47.

Two males, June 24, July 15; one pair in copula May 26, Phila., S. F. Aaron (A. E. S., C.). Tinicum Is., Sept. 4, 1888, P. P. Calvert.

Pennsylvania, Maryland, Michigan, Illinois, Missouri, Texas, Mexico, Sandwich Is. (Cabot, Kirby).

30. **Libellula** Linné.

Linné, Syst. Nat. i, p. 543, 1758. Hagen, Syn. Neur. N. A., p. 150, 1861 (in part). *Leptetrum*, *Belonia*, *Holotania* Kirby, Trans. Zool. Soc. Lond., xii, pp. 286, 288, 1889.

*A. Basal half to third of the wings blackish brown for the entire width or nearly so.*
♀ *with lateral margins of* 8 *not produced.*

**47. Libellula basalis** Say.

*L. b.* Say, Jour. Ac. Phila., viii, p. 23, 1839. *L. luctuosa* Burm., Hagen, Syn. Neur. N. A., p. 152, 1861.

Blackish brown; a mid-dorsal thoracic stripe and a stripe on each side of dorsum of 2–9, yellow. Wings with *basal half to third blackish brown*, outer edge of the brown frequently margined with chalky white; apex sometimes brown. Pterostigma *black*. Thorax and abdomen of old males pruinose.

Abd. ♂ 28–31, ♀ 26–27.5. H. w. ♂ 37–41, ♀ 37–39.

Abundant around Phila., June 1—Sept. 10; ovipositing July 3.

New York and Ontario to Virginia, west to South Dakota, Kansas and Texas (Cheney, Truman, Owen, A. E. S.).

*B. No brown basal band of the entire width of the wings.*

*a. Wings unspotted at base; pterostigma unicolorous, red or yellow. ♀ with lateral margins of 8 produced ventrally ("perfoliate").*

**Libellula auripennis** Burmeister.

*L. a.* Burm., Handb. Ent. ii, p. 861, 1839. Scudder, Proc. Bost. Soc. N. H. x, p. 191, 1866.

Yellowish (teneral), through yellowish brown to red; a mid-dorsal yellow thoracic stripe (teneral); abdomen posteriorly with a mid-dorsal black stripe. Wings with a *yellowish or reddish tinge*, especially along front margin, extreme apex sometimes brownish. Pterostigma *yellow or red.*

Abd. ♂ 34.5–40, ♀ 31–36.5. H. w. ♂ 36–43, ♀ 36–41.5.

On and near the sea-coast from New York to Texas; Ohio, Cuba, Isle of Pines.

*b. Wings with dark basal markings, when present, in the form of a narrow streak confined to the space between the subcostal and median veins; pterostigma blackish brown, or bicolored, yellow and blackish brown. ♀ with 8 perfoliate.*

**Libellula plumbea** Uhler.

*L. p.* Uhler, Proc. Ac. Phila., 1857, p. 87. Hagen, Syn. Neur. N. A., p. 157, 1861.

Frons and lips yellowish brown or olive. Thoracic dorsum and a stripe on second lateral suture, reddish brown; a median dorsal thoracic stripe and the sides yellow. Abdomen yellowish, a mid-dorsal stripe on 2–10. Wings with front margin yellowish, a *brown basal streak* between subcostal and median veins out to the first or second antecubital. Pterostigma *yellow, darker at distal end.*

♂. Face and labrum blackish brown, thorax and abdomen pruinose dorsally, in older males.

♀. Apex of wings *from beneath the pterostigma* dark brown.

Abd. ♂ 31, ♀ 29. H. w. ♂ 36–38.5, ♀ 38–39.

New York to South Carolina (Beutenmüller, Skinner, L. O. Patterson, C.).

**48. Libellula cyanea** Fabricius.

*L. c.* Fabr., Syst. Ent. p. 424, 1775. *L. quadrupla* Say, Jour. Ac. Phila., viii, p. 23, 1839. Hagen, Syn. Neur. N. A., p. 157, 1861.

Yellow; thoracic dorsum, a mid-lateral thoracic stripe, a mid-dorsal stripe on 2–10, brown; a yellow mid-dorsal thoracic stripe. Wings with base and front margins yellowish, *a dark brown basal streak* as in *plumbea*. Pterostigma *distinctly bicolored, inner half yellow or white, outer half dark brown.*

♂. Face and lips blackish, thorax and abdomen blue pruinose in old males.

♀. Apex of wings *from distal end of pterostigma* brown. In old females the brown encroaches much on the yellow of the thorax.

Abd. ♂ 27.5–30.5, ♀ 24.5–28. H. w. ♂ 33–37, ♀ 32–36.

Abundant around Phila., June 3—Aug. 8; 1 ♂, Sept. 10, 1891; ovipositing or in copula June 24, July 4.

Massachusetts to Virginia (Beutenmüller, Richardson).

N. B.—*Libellula flavida* Hagen (Syn. Neur. N. A., p. 156), not of Rambur, differs from *plumbea* and *cyanea* in having *no* dark brown basal streak to the wings: the apex of the wings in *both* ♂ *and* ♀ *is barely edged* with brown; pterostigma most like that of *cyanea*. Abd. ♂ 33.5–36, ♀ 31–33. H. w. ♂ 41–43, ♀ 40–41.5. Texas. The *flavida* of Rambur (Ins. Nevr. p. 58) is different from *flavida* Hag. and may perhaps be identical with *plumbea*. These three forms are closely allied.

**Libellula axillena** Westwood.

*L. a.* Westwood's edit. of Drury, Ill. Exot. ii, p. 85, pl. 47, fig. 1, 1837. *L. lydia* Drury, *l. c.*, 1773. *L. a.* Duncan, Introd. p. 292, pl. 29, fig. 1, 1840. Hagen, Syn. Neur. N. A., p. 156, 1861.

Inner margins of lateral labial lobes blackish. Thoracic dorsum reddish brown, a mid-dorsal stripe and sides yellow; a mark on second lateral suture and some near coxæ, blackish brown. Abdomen yellow, sides of 1–3, sutures and a mid-dorsal stripe on 2–10, blackish. *Wings* with a basal streak between subcosta and median to beyond the level of the arculus, a nodal dot, a streak confined to the first postcubital series, and the extreme apex, blackish brown. Pterostigma *blackish*.

♂. *Anterior surface of frons and clypeus, labrum, black; frons above metallic blue.* Thorax and abdomen blue pruinose in old males.

♀. *Frons reddish or yellowish, above metallic blue;* nasus pale green or yellow, rhinarium and labrum partly or entirely black.

Abd. ♂ 37–42, ♀ 37–38.5. H. w. ♂ 41–45, ♀ 42–42.5.

Georgia, Florida, Louisiana.

**49.** form **vibrans** (Fabricius?) Kirby, Cat. Odon. p. 29, 1890. *L lydia* Hagen, Syn. Neur. N. A., p. 155, 1861.

Differs from *axillena* as follows: *frons, clypeus and labrum white, pale green, or yellow.* Usually *no brown streak on first postcubital series.*

Abd. ♂ 37–42, ♀ 37–38.5. H. w. ♂ 47–50, ♀ 45–47.

One male, June 10, Phila., S. F. Aaron (A. E. S.). One male, July 5, 1890, one female, July 3, 1893, Ridley Twp., Del. Co., Pa., P. P. Calvert (C.).

Pennsylvania and New Jersey to Texas.

form **incesta** Hagen, Syn. Neur. N. A., p. 155, 1861; Psyche v, p. 384, 1890. Calvert, Trans. Am. Ent. Soc. xvii, p. 34, 1890.

Differs from *axillena* as follows: ♂. Wings usually *unspotted*, sometimes with a small nodal spot. *Labrum yellowish*, face black, frons above dark metallic blue, in old males. ♀. Wings with the basal streak usually very short, extreme tips not always brownish, other wing spots wanting. *Face yellowish, frons above brown.*

Abd. ♂ 33–39, ♀ 31–34. H. w. ♂ 37–40, ♀ 37.5–39.

Canada to Florida (Hagen).

*c. Hind wings with a dark brown, triangular, basal spot reaching backwards to the apex of the membranule.* ♀ *with* 8 *not perfoliate.*

**50. Libellula exusta** Say.

*L. e.* Say, Jour. Ac. Phila. viii, p. 29, 1839. *L. deplanata* Rambur, Ins. Nevr. p. 75, 1842. Hagen, Syn. Neur. N. A., p. 154, 1861. *L. julia* Uhler (*teste* Hagen).

Reddish brown. Thorax with an *olive or yellow antehumeral stripe.* Abdomen with a mid-dorsal black stripe. Wing-bases yellowish. Front wings with *two dark brown basal streaks.* Hind wings with *a superior basal streak* and an *inferior, triangular, basal spot* of varying size, dark brown, distal ends of these two sometimes united. Thorax and abdomen white pruinose in old males.

Abd. ♂ 22–27, ♀ 20.5–24. H. w. ♂ 27–33, ♀ 26.5–32.5.

Atco, N. J., June 4, 18, C. W. Johnson (W. I., A. E. S., C.). One female, Pa. (A. E. S.)

Maine and Massachusetts to Vancouver's Is.; New Jersey, Pennsylvania, Georgia.

N. B.—Dr. Hagen states (Proc. Bost. Soc. N. H. xviii, p. 69), "*L. deplanata* seemed to be a dwarfish southern form [of *exusta*,] but there are differences in the genital parts, probably important enough to separate the two species." Thanks to the kindness of Mr. Samuel Henshaw, the writer has examined drawings of the appendages of male and female of *exusta* and *deplanata* contained in the Museum of Comparative Zoology at Cambridge, Mass. A comparison of these drawings with specimens in his own collection does not reveal differences constant enough to serve as specific.

**51. Libellula quadrimaculata** Linné.

*L. q.* Linné, Syst. Nat. i, p. 543, 1758. Hagen, Syn. Neur. N. A., p. 150, 1861.

Olive or yellowish. Humeral and second lateral thoracic sutures black with adjacent inferior brighter yellow marks; a bright yellow spot each side of 2–9, dorsum of 6–10 blackish. Wings yellow at base or along front margin, and *a small black nodal spot;* hind wings in addition with *a black, basal, triangular spot* below the submedian vein and filling the triangle, thence running obliquely to the anal margin a little beyond the apex of the membranule; this spot veined with yellow. Var. *prenubila* has a brownish cloud beneath the pterostigma. ♀ App. a little longer than 9.

Abd. ♂ 26–31, ♀ 27–31. H. w. ♂ 33–36, ♀ 34–36.

Atco, N. J., June 18, C. W. Johnson (W. I., A. E. S., C.).

Nova Scotia to Massachusetts, west to Washington and northward; New Jersey, Illinois, Utah, Wyoming; Europe (except the Mediterranean Is.), Northern and Central Asia, Asia Minor. See p. 206.

*d. Hind wings at least with a longitudinal basal stripe (whose hind margin lies at least as far back as the postcosta), a nodal spot extending half across the wing, and a band crossing the wing at apex or at pterostigma—all three dark brown or reddish brown.* ♀ *with* 8 *perfoliate.*

**52. Libellula semifasciata** Burmeister.

*L. s.* Burm., Handb. Ent. ii, p. 862, 1839. Hagen, Syn. Neur. N. A., p. 151, 1861.

Reddish brown. Thorax each side with two white or yellow stripes; a yellow spot on each side of 2–10. Wing-bases yellowish; the following *reddish brown:* the nodal spot, *a pterostigmal band*, sometimes the apices of all four, sometimes a small anal spot on hind wings; the following blackish brown: on the front wings *the apical half of the median space and the first few cells between the sectors of the arculus*, on the hind wings the basal stripe to the outer angle of the triangle. Pterostigma *reddish brown.*

Abd. ♂ 26–29, ♀ 25–28. H. w. ♂ 35–37, ♀ 34–38.

Fairly abundant around Phila., May 17—July 22.

Maine to Florida, west to Michigan and Texas.

**53. Libellula pulchella** Drury.

*L. p.* Drury, Ill. Exot. Ent. i, p. 115, pl. 48, fig. 5, 1770. Hagen, Syn. Neur. N. A., p. 153, 1861.

Blackish brown. Thorax each side with two stripes, a stripe on each side of 1–9 or 10, yellow. Wings with a longitudinal basal stripe between subcosta and postcosta out to beyond the triangle, a large nodal spot, and *apex, blackish brown.* Pterostigma *blackish brown.* ♂. Wings with milky spots adjacent to dark brown ones; abdomen pruinose in old males.

Abd. ♂ 32–35, ♀ 30–33. H. w. ♂ 40–43, ♀ 41–43.

Very abundant around Phila., May 30—Sept. 14; in copula or ovipositing June 18, 22, July 2, 20, 23, Aug. 16, 18.

Quebec to Georgia, west to Utah and Texas; California (A. E. S.).

N. B.—The females of *L. pulchella* and *Plathemis trimaculata* resemble each other, and are often confounded. The former is to be recognized by its larger size, its larger yellow spots on the sides of the abdomen forming a band, and by its relatively shorter pterostigma, which is three-eighths as long as the first postcubital space, while that of *trimaculata* is one-half as long as that space.

### 31. **Plathemis** Hagen.

Hagen, Syn. Neur. N. A., p. 149, 1861. Kirby, Trans. Zool. Soc. Lond. xii, p. 287, 1889.

**54. Plathemis trimaculata** De Geer.

*Libellula t.* De Geer, Mém. iii, p. 556, tab. 26, fig. 2, 1773. *P. t.* Hagen, Syn. Neur. N. A., p. 149, 1861. *Libellula lydia* Drury, Ill. Exot. Ent. i, p. 112, pl. xlvii, fig. 4, 1770. Drury's name has a priority of three years, but as *trimaculata* is widely known as the name of this species, no change is here made.

Brown. Thorax each side with two white stripes each terminated below by a yellow spot; a white or yellow spot each side of 2–9.

♂. Wings with a longitudinal basal stripe between subcosta and postcosta as far as the triangle and clearer in the middle, a band across the wing from nodus to pterostigma, and sometimes the extreme apex, blackish brown; a chalky-white cloud below the basal stripe. Thorax (partly) and abdomen white pruinose in older males.

♀. Wings with a basal stripe as in ♂, a nodal patch reaching half across the wing and apex, blackish brown; 8 perfoliate. See note to *Libellula pulchella.*

Abd. ♂ 25.5–30, ♀ 23–24. H. w. ♂ 31–34.5, ♀ 32–33.5.

Very abundant around Phila., May 17—Sept. 9; ovipositing June 21, 24, July 2, 17.

Quebec to Florida, west to Colorado; Pacific coast from Washington to Southern California (O. B. Johnson, Davidson, Behrens, A. E. S.).

### 32. **Micrathyria** Kirby.

Kirby, Trans. Zool. Soc. Lond. xii, p. 303, 1889. Karsch, Berl. Ent. Zeit. xxxiii, p. 371, 1890.

**55. Micrathyria berenice** Drury.

*Libellula b.* Drury, Ill. Exot. Ent. i, p. 114, pl. 48, fig. 3, 1770. *Diplax b.* Hagen, Syn. Neur. N. A., p 178, 1861.

♂. Black. Frons and vertex metallic blue, nasus with *a yellow spot each side* and sometimes also the lateral labial lobes: some yellow spots near the coxæ; 3-7 with a yellow or orange spot each side of dorsum; thorax and abdomen entirely dark blue pruinose in old individuals. Wings uncolored.

♀ form I. Only the extreme base of the wings yellowish. Abdomen as in ♂ but 10 *yellow*; vulvar lamina longer than 9, projecting, apex pointed, margins entire. Head and thorax colored as in ♂, or as in form II.

♀ form II. Wings with the extreme base and a large middle cloud yellowish or reddish brown. Frons as in ♂, but with a yellow spot each side; tip of vertex, nasus, labrum, greater part of labium, yellow. *Thorax* yellow, a mid-dorsal stripe, two antehumeral and five lateral stripes each side black. Abdomen black, 1-7 with a large dorsal spot and 10 *entirely*, yellow.

Abd. ♂ 23, ♀ I 22-22.5, ♀ II 21-22. H. w. ♂ 23-24.5, ♀ I and II 24-25.

One male, Folsom, Del. Co., Pa., July 5, 1890, P. P. Calvert (C.).

A coast species, Massachusetts to Virginia; Bahamas, Texas (Moore and Bullock, A. E. S.).

### 33. **Nannothemis** Brauer.

Brauer, Verh. z.-b. Gesell. Wien xviii, p. 369, 726, 1868. Kirby, Trans. Zool. Soc. Lond. xii, p. 312, 1889. Karsch, Ent. Nach. xv, p. 255, 259 (in part only), 1889.

**56. Nannothemis bella** Uhler.

*Nannophya b.* Uhler, Proc. Ac. Phila. 1857, p. 87. Hagen, Syn. Neur. N. A., p. 186, 1861.

Black; frons and nasus *white or pale yellow, with a median quadrate black spot* which is confluent with the black labrum. Vertex metallic-blue or green.

♂. Thorax and abdomen black, pruinose white in older males.

♀. Thorax with a yellow antehumeral stripe, sides yellow, with two oblique black lines. The following yellow: a transverse basal band on 2-4, a basal spot on 5-7, entire dorsum of 10. Vulvar lamina reaching apex of 10, only slightly projecting, apex rounded, entire. Wings yellowish on basal third.

Abd. ♂ 12.5-13, ♀ 11-13.5. H. w. ♂ 14.5-16, ♀ 14-16.5.

Phila., July 22, S. F. Aaron (A. E. S,). Berlin, N. J., July 17, P. P. Calvert (C.).

Ontario to Georgia.

34. **Celithemis** Hagen,

Hagen, Syn. Neur. N. A., p. 147, 1861. Kirby, Trans. Zool. Soc. Lond. xii, p. 274, 1889.

**Celithemis ornata** Rambur.

*Libellula o.* Ramb., Ins. Nevr. p. 96, 1842. *Diplax o., D. amanda* Hagen, Syn. Neur. N. A., pp. 182, 183, 1861.

Yellow. Median labial lobe yellow (*amanda*) to black (*ornata*). The following black: frons above, rear of head, a broad mid-dorsal thoracic stripe, sometimes a humeral and two lateral thoracic stripes. Abdomen black, a yellow dorsal spot of varying extent on 2 or 3–7. *Hind wings* yellow at base, the following brown: an oblique stripe from submedian vein to membranule, behind it a parallel stripe of varying extent, and a spot at the triangle, which may unite with the latter stripe; sometimes a basal brown stripe between subcostal and median veins, and then the spot at the triangle united with the first mentioned oblique stripe; in the extreme individuals all the spots and stripes more or less united and darker. Thorax and abdomen of old males entirely black.

Abd. ♂ 17.5–22, 15.5–19. H. w. ♂ 22–27, ♀ 20–23.

A coast species, Maine to Florida.

**57. Celithemis elisa** Hagen.

*Diplax e.* Hagen, Syn. Neur. N. A., p. 182, 1861.

Yellow (teneral) to red; the following black: median lobe and inner edge of lateral labial lobes, a mid-dorsal thoracic, a humeral and two lateral stripes. Abdomen black, a basal dorsal spot on 2 or 3–7 and sides of 1–3, yellow or orange. *Front wings* yellowish at base and along front margin; antecubitals, median space, nodus and front side of triangle with dark brown spots; a larger *spot* (sometimes almost absent) *between nodus and pterostigma*, and the apex, dark brown. Hind wings similar, spot at the triangle extended to base (= first oblique stripe + spot at triangle of *ornata*), and an anal spot (= second oblique stripe of *ornata*) which may or may not unite with the spot at the triangle. Pterostigma yellow or red.

Abd. ♂ 19.5–22.5, ♀ 18.5–20.5. H. w. ♂ 25.5–27.5 ♀ 23–26.5.

Three males, Phila., June 2, 10, S. F. Aaron (A. E. S.). Berlin, N. J., July 17, P. P. Calvert. Clementon, N. J. (W. I.).

Canada to Georgia; Michigan, Illinois.

**58. Celithemis eponina** Drury.

*Libellula e.* Drury, Ill. Exot. Ent. ii, p. 86, pl. 47, fig. 2, 1773. *C. e.* Hagen, Syn. Neur. N. A., p. 147, 1861.

Reddish yellow. Thorax with a mid-dorsal and two lateral stripes blackish. Abdomen black, an elongated mid-dorsal spot on 2 or 3–7, sides of 1–3, yellow or orange. Wings yellowish, veins yellowish. *Front wings* with a patch from the arculus to the triangle, *a nodal band* (which may be broken into an anterior and a posterior spot), *a band at inner end of pterostigma*, and sometimes the apex, blackish brown. Hind wings similar, patch extended to base (= first oblique stripe + spot at triangle of *ornata*) and sometimes outwards to nodal band, and a large spot near anal angle (= second oblique stripe of *ornata*). The size of the wing-markings varies greatly. Pterostigma yellow or red.

Abd. ♂ 24–28, ♀ 21–26. H. w. ♂ 31–35.5, ♀ 31–34.5.

One male, Phila., July 22, S. F. Aaron (A. E. S.). One male, on Delaware River opposite Eddystone, Pa., July 28, 1886, P. P. Calvert (C.).

United States east of the Rocky Mts., Cuba.

### 35. **Leucorhinia** Brittinger.

Britt., Sitzb. Ak. Wiss. Wien, 1850, iv, p. 333. Hagen, Trans. Am. Ent. Soc. xvii, p. 229, 1890.

#### 59. **Leucorhinia intacta** Hagen.

*Diplax i.* Hagen, Syn. Neur. N. A., p. 179, 1861. *L. i.* Calvert, Trans. Am. Ent. Soc. xvii, p. 39, pl. v, figs. 1, 7–9, 1890. Hagen, *l. c.* p. 235, pl. x, figs. 6, 8, 15, 16, 23, 1890.

Blackish. Labrum white or yellow; an orange or yellow dorsal spot on 2–7 (only on 7 in old individuals). Front wings with two very short basal streaks, hind wings with a short, superior, basal streak and an inferior, triangular, basal spot, blackish.

♂. Inf. app. *bifid*, its branches *divergent, pointed.* Anterior lamina each side with *an elevated black tubercle covered with small spines.*

♀. Vulvar lamina forming two *slender, separated lobes; two small ventral palps* on the middle of 9.

Abd. ♂ 21–22, ♀ 20–22. H. w. ♂ 23.5–25, ♀ 25–26.5.

Two males, Phila., June 17; one male, Bristol, Pa., June 16, S. F. Aaron (A. E. S.). One female (others seen), Ridley Twp., Del. Co., Pa., July 3, 1893, P. P. Calvert (C.).

Canada to Pennsylvania, west to South Dakota; Nevada, Washington.

### 36. **Diplax** Charpentier.

Charp., Lib. Eur. p. 12, 1840. Selys, Ann. Soc. Ent. Belg. xxxii, p. 134, 1888. *Sympetrum* Newman, Ent. Mag. i, p. 511, 1833. Kirby, Trans. Zool. Soc. Lond. xii, p. 276, 1889.

*A. No additional transverse carina on* 4.

*a.* ♂. *Sup. app. with a prominent, inferior, median tooth, on whose basal side are* 5–8 *denticles.* ♀. *Vulvar lamina bifid.*

#### 60. **Diplax rubicundula** Say (Pl. II, fig. 5).

*Libellula r.* Say, Jour. Ac. Phila. viii, p. 26, 1839. *Diplax r.* Hagen, Psyche v, p. 385, 1890.

Yellowish (teneral) to red; lateral margins of 3–10, especially near apices, black. Legs black, femora paler inferiorly. Extreme base of wings yellowish.

♂. Genital hamule with *a little more than the apical third bifid*, internal (anterior) branch slightly longer, its apex more acute and slightly bent towards the external branch; external (posterior) branch *twice as wide* as the internal. Genital lobe projecting no farther ventrally than the external hamular branch, *not* widened towards apex.

♀. Vulvar lamina not elevated, bifid, lobes approximate, small, rounded to pointed at tips.

Abd. ♂ 21.5–25, ♀ 19.5–24.5. H. w. ♂ 22–28, ♀ 22.5–27.5.

Very abundant around Phila., July 1—Sept. 20.

Nova Scotia to Maryland, west to Lake Superior and Illinois.

Var. **assimilata** Uhler (Proc. Ac. Phila. 1857, p. 88, *Libellula a.*) has the basal half of the wings yellowish.

Abd. ♂ 22.5–27, ♀ 22–25. H. w. ♂ 25–29.5, ♀ 24.5–28.5.

One male, Ridley Twp., Del. Co., Pa., July 3, 1893, P. P. Calvert. One male, Westville, N. J., Aug. 27, 1892, P. Nell (C.).

New Jersey to South Dakota and Nebraska.

**Diplax obtrusa** Hagen (Pl. II, fig. 6).

*D. o.* Hagen, Stet. Ent. Zeit. xxviii, p. 95, 1867; note after *D. rubicundula* Syn. Neur. N. A., p. 177, 1861.

Differs from *rubicundula* as follows: ♂. Genital hamule with *apical fourth bifid*, branches proportionally shorter, external branch at least *four times wider* than internal branch. ♀. Apparently not distinguishable from that of *rubicundula*.

Abd. ♂ 22–25, ♀ 23.5–24. H. w. ♂ 21–25, ♀ 23–25.5.

Nova Scotia to Pennsylvania, west to Wisconsin; Colorado, Washington (Sheraton, J. P. Moore, Mrs. Slosson, E. M. Aaron, G. Miller, Owen, Mich. Agr. Coll., Col. Agr. Coll., O. B. Johnson).

*b. Sup. app. with no prominent inferior tooth, but with 4–9 inferior denticles, of which the most apical is largest.* ♀. *Vulvar lamina entire.*

**61. Diplax semicincta** Say (Pl. II, fig. 3).

*Libellula s.* Say, Jour. Ac. Phila. viii, p. 27, 1839. *D. s.* Hagen, Syn. Neur. N. A., p. 176, 1861.

Yellowish (teneral) to reddish brown; lateral margins of 3 or 4–10, and sometimes a mid-dorsal stripe on 8 and 9, black.

♂. Front wings with *basal half to third*, hind wings with *basal half, yellowish or brown*, clearer at extreme base. Hamule *bifid in its apical half*, internal (anterior) branch slightly shorter, slender, *more erect*, slightly hooked at tip, which is acute; external (posterior) branch two to three times stouter, its tip less acute, bent slightly outwards and backwards. Genital lobe projecting ventrally a little farther than external hamular branch, *slightly wider towards apex*. Legs black, first femora paler inferiorly.

♀. Wings yellowish at basal half, or only as far as the triangle. Vulvar lamina very short, projecting but slightly, margin entire.

Abd. ♂ 17–24, ♀ 19–23 5. H. w. ♂ 21–27, ♀ 23–26.5.

Two males, Phila., July 15, S. F. Aaron (A. E. S.). Two males, one ♀, Ridley Twp., Del. Co., Pa., July 3, 1893, P. P. Calvert (C.).

Maine to Maryland; Colorado, New Mexico, Nevada, California (Beales, Cockerell, Hillman, A. E. S,).

N. B.—The specimens of *semicincta* from Nevada, Colorado and California, have black stripes on the humeral and lateral thoracic sutures, which are absent in those from Pennsylvania.

**62. Diplax vicina** Hagen (Pl. II, fig. 4).

*D. v.* Hagen, Syn. Neur. N. A., p. 175, 1861.

Yellowish (teneral) to red; lateral margins of 3-9, and frequently a mid-dorsal stripe on 8 and 9, blackish brown. Extreme base of wings yellow. Legs yellowish to reddish.

♂. Hamule *bifid in its apical two-thirds*, branches of nearly equal length, *both almost erect*, internal (anterior) branch more slender, apex acute; external branch two to three times wider, *apex rounded*. Genital lobe projecting slightly farther ventrally than the hamule.

♀. Vulvar lamina *distinctly projecting*, its margin entire.

Abd. ♂ 20.5-23.5, ♀ 20.5-23.5. H. w. ♂ 22-25, ♀ 21.5-24.

Very abundant around Phila., July 11—Oct. 26, and probably later; in copula or ovipositing Aug. 31, Sept. 3, 10, 19, 21, Oct. 11, 12, 24.

Maine to Virginia; Ontario, Illinois (Miss Wadsworth, Harvey, Richardson).

*B. An additional transverse carina on* 4.

**63. Diplax corrupta** Hagen.

*Mesothemis c.* Hagen, Syn. Neur. N. A., p. 171, 1861.

Olive or brown; face, *an antehumeral stripe, two lateral thoracic stripes*, white or yellow. Abdomen yellowish, spotted with white and brown, 8-9 with a mid-dorsal black spot. Wing-veins yellowish. Pterostigma yellow, brown in the middle. Legs black, femora and tibiæ with *a superior yellow stripe*.

♂. Hamule with *apical third bifid*, internal branch short, slender, apex acute, curved outwards to form a hook; external branch *twice as long, much thicker*, directed outwards and backwards, apex blunt. Genital lobe projecting a little farther ventrally than the external hamular branch. *Sup. app.* yellow, thickened in their apical half, with a row of 9-14 inferior, black denticles.

♀. Vulvar lamina *not projecting*, apex *emarginated*.

Abd. ♂ 24.5-28.5, ♀ 25-29. H. w. ♂ 27.5-31, ♀ 28-32.

One male, Folsom, Del. Co., Pa., Oct. 3, 1889, P. P. Calvert (C.). Pennsylvania; Illinois to California, Montana to Mexico; Ochotsk.

### 37. **Perithemis** Hagen.

Hagen, Syn. Neur. N. A., p. 185, 1861. Kirby, Trans. Zool. Soc. Lond. xii, p. 273, 1889.

**64. Perithemis domitia** Drury.

*Libellula d.* Drury, Ill. Exot. Ent. ii, p. 83, pl. 45, fig. 4, 1773. *P. d.* Hagen, *l. c.* p. 185, 1861.

Yellowish brown. Thorax sometimes with two lateral yellow stripes of varying width. Abdomen with some yellow marks.

♂. Wings brownish yellow, sometimes a dark reddish brown spot near the outer angle of the triangle, sometimes a short, basal, brown streak on hind wings. Pterostigma reddish brown.

♀. Front wings with a patch near the outer angle of the triangle and a ragged nodal band, brown. Hind wings similar, the patch larger, prolonged at its hind end and turned inwards towards the anal angle. Front and hind wings with brown markings bordered with yellow, sometimes a brown basal streak in the subcostal space. Pterostigma yellowish brown.

Abd. ♂ 13–15, ♀ 11–14.5. H. w. ♂ 16–19, ♀ 14.5–19.5.

Common around Phila., June 17—Aug. 31,

United States east of the Mississippi River; Texas, Argentine Republic, West Indies.

N. B.—Kirby (Cat. Odon. p. 10) holds that *tenera* Say is the proper name of this species found in the U. S., and that *domitia* Drury is distinct. It is here preferred to follow Dr. Hagen, who regards *tenera* and many other names as synonyms of a very variable species—*domitia*. Thus females from Florida have the hind margin of all the wings narrowly edged with brown from the nodal band to the apex, and the nodal band and the patch on the triangle sometimes confluent.

### 38. **Mesothemis** Hagen.

Hagen, Syn. Neur. N. A., p. 170, 1861. Kirby, Trans. Zool. Soc. Lond. xii, p. 303, 1889.

### **65. Mesothemis simplicicollis** Say.

*Libellula s.* Say, Jour. Ac. Phila. viii, p. 28, 1839. *M. s.* Hagen, *l. c.* p. 170, 1861.

Bright green; thorax frequently with mid-dorsal carina, antehumeral, humeral and two indistinct lateral lines, and some marks near the coxæ, black; 1–3 mostly green, 4–10 with a mid-dorsal black band on apical half, or 8–10 entirely black.

♂. Sup. app. *yellow*. Thorax and abdomen entirely blue pruinose in old males.

♀. Vulvar lamina erect, triangular, entire.

Abd. ♂ 26–33, ♀ 28–29.5. H. w. ♂ 27–35, ♀ 31–33.

Common around Phila., June 10—Aug. 8; ovipositing June 17, 22, July 26.

United States east of the Rocky Mts., Mexico, West Indies, Bahamas (Fox and Johnson, Moore and Bullock).

### 39. **Pachydiplax** Brauer.

Brauer, Verh. z.-bot. Gesell. Wien, pp. 368, 722, 1868. Kirby, Trans. Zool. Soc. Lond. xii, p. 305, 1889.

### **66. Pachydiplax longipennis** Burmeister.

*Libellula l.* Burm., Handb. Ent. ii, p. 850, 1839. *Mesothemis l.* Hagen, Syn. Neur. N. A., p. 173, 1861.

Blackish brown. Face white, frons above and vertex metallic blue. Thorax with a short antehumeral stripe, a transverse stripe in front of the antealar sinus, and frequently the mid-dorsal carina, yellowish; sides pale green with three brown stripes.

♂. Abdomen blackish, often pruinose, sides of 1-3 yellowish, or similar to that of ♀ (teneral). Wings yellowish at base, especially the hind wings, which have two longitudinal, dark brown basal streaks; a yellowish or brownish cloud frequently present between nodus and pterostigma, apices sometimes smoky. The extent and intensity of the wing coloring vary greatly, even in specimens of the same locality at the same time.

♀. Abdomen widened at tip, black, a pale green or yellow longitudinal stripe on each side of dorsum of 2-7, sides of 1-5 yellowish. Vulvar lamina prolonged (so that the vulva lies on the middle of 9), emarginated in the middle. Wings yellowish at extreme base, no streaks or clouds. Abdomen occasionally pruinose in old females.

Abd. ♂ 20-28, ♀ 20.5-25. H. w. ♂ 23-33.5, ♀ 28-32.

Common around Phila., June 10—Sept. 4; ovipositing June 14.

Massachusetts to Florida, west to the Mississippi; Bahamas (Moore and Bullock), Texas, Mexico, Montana, California, Vancouver's Is.

# PART III.

## A SUMMARY OF THE PHILADELPHIA ODONATE FAUNA.

### SCOPE OF THIS CATALOGUE.

The species whose names are numbered in Part II have been certainly observed within a radius of twenty miles from the Philadelphia City Hall. This arbitrary limit has been fixed by the fact that the observations upon which this paper is based have been mainly confined to the region indicated. The unnumbered species may, from what is now known of their distribution, hereafter be found in this district. The Odonate fauna of Philadelphia is, therefore, here considered to consist of the following species:

Subfam. CALOPTERYGINÆ (4 sp.)

1. Calopteryx maculata
2. C. dimidiata, race apicalis*
3. Hetærina americana
4. " tricolor*

Subfam. AGRIONINÆ (19 species).

5. Lestes forcipata
6. " rectangularis
7. " inequalis
8. Argia putrida

9. " violacea
10. " tibialis
11. " apicalis
12. " bipunctulata
13. Nehalennia irene*
14. " posita
15. Amphiagrion saucium
16. Enallagma durum*
17. " civile
18. " divagans*
19. " exsulans
20. " signatum
21. Ischnura verticalis
22. " Ramburii
23. Anomalagrion hastatum

Subfamily GOMPHINÆ (7 species).

24. Gomphus abbreviatus*
25. " exilis
26. " minutus*
27. " plagiatus
28. " villosipes
29. " vastus*
30. Dromogomphus spinosus

Subfamily AESCHNINÆ (6 species).

31. Epiæschna heros
32. Fonscolombia vinosa†
33. Gomphæschna furcillata var. antilope*
34. Aeschna juncea var. verticalis
35. " constricta
36. Anax junius

Subfam. CORDULINÆ (6 species).

37. Didymops transversa*
38. Macromia tæniolata*
39. " illinoensis*
40. Epicordulia princeps*
41. Tetragoneuria cynosura
42. Somatochlora lepida*

Subfam. LIBELLULINÆ (24 species).

43. Pantala flavescens*
44. " hymenæa*
45. Tramea carolina*
46. " lacerata*
47. Libellula basalis
48. " cyanea
49. " axillena form vibrans*
50. " exusta
51. " quadrimaculata
52. " semifasciata
53. " pulchella
54. Plathemis trimaculata
55. Micrathyria berenice*
56. Nannothemis bella
57. Celithemis elisa
58. " eponina*
59. Leucorhinia intacta
60. Diplax rubicundula
61. " semicincta
62. " vicina
63. " corrupta*
64. Perithemis domitia
65 Mesothemis simplicicollis
66. Pachydiplax longipennis

Of those species marked with an asterisk (*), only five individuals or less, are known from within the twenty-mile radius.

## SEASONAL DISTRIBUTION (Imagos).

The species of Odonata which appear first in the year around Philadelphia are *Anax junius*, *Ischnura verticalis* and *Nehalennia posita*. The earliest date recorded for them is May 1, but they are probably to be found still earlier. From the data contained in Part II, it appears that the number of species to be found on any one day increases from 3 to 14 during May, from 14 to 32 during June, decreases from 32 to 23 during July, from 22 to 21 during

† On Sept. 18, 1893, the writer took one ♂ and saw another of *vinosa* by a brook in Springfield Twp., Del. Co., Pa.

August, and from 20 to 5 during September. The species which continues to fly latest into the Autumn is *Diplax vicina*, having been observed up to October 26, and probably to be found still later, as Mr. G. D. W. Williamson has taken it at Dobb's Ferry, New York, on November 8. The maximum number of species on the wing at any one time is thus 32 from June 24 to July 1.

TABLE SHOWING THE SEASONAL DISTRIBUTION OF THE SUBFAMILIES OF THE ODONATA OF PHILADELPHIA.

| Subfamily. | Earliest appearing species. | Latest appearing species. | Maximum number of species at one time. |
|---|---|---|---|
| Calopteryginæ | Calopteryx maculata May 24. | Hetærina americana Sept. 23, | Two, Aug. 11-17. |
| Agrioninæ | I. verticalis, N. posita May 1. | I. verticalis, Oct. 16. | Thirteen, June 28–July 4. |
| Gomphinæ | Gomphus exilis, May 24. | Gomphus plagiatus, July 17. | Four, June 22-26. |
| Aeschninæ | Anax junius, May 1. | Aeschna constricta, Oct. 18. | Four, Aug. 28-29. |
| Cordulinæ | D. transversa, May 13. | Epicordulia princeps July 1. | Three, June 18. |
| Libellulinæ | P. trimaculata, L. semifasciata, May 17. | Diplax vicina, Oct 26. | Thirteen, July 5-22. |

## GEOGRAPHICAL DISTRIBUTION.

Of the 33 genera represented in the foregoing list, 8 (*Dromogomphus, Gomphæschna, Didymops, Epicordulia, Tetragoneuria, Plathemis, Nannothemis, Pachydiplax*) are exclusively Nearctic, 8 (*Hetærina, Amphiagrion, Anomalagrion, Epiæschna, Micrathyria, Celithemis, Perithemis, Mesothemis*) are confined to the New World, 3 (*Calopteryx, Fonscolombia, Leucorhinia*) are restricted to the Palæarctic and Nearctic provinces, while the remaining 14 are more widely distributed.

The great majority (49) of the sixty-six species of the preceding list are confined to the Alleghenian subdivision of the Nearctic zoögeographical province, *i. e.* to that portion of the United States east of the Rocky Mountains. Of the remainder—

*Pantala flavescens* is a well-known cosmopolitan species.

*Aeschna juncea* and *Libellula quadrimaculata* are diffused throughout the northern hemisphere.

*Ischnura Ramburii, Anomalagrion hastatum, Anax junius, Pantala hymenæa, Celithemis eponina, Perithemis domitia* and *Mesothemis simplicicollis* are also West Indian.

*Lestes forcipata, Anax junius, Libellula quadrimaculata, Diplax semicincta* and *D. corrupta* also occur in the region between the

Rocky Mountains and the Sierra Nevada. Except the single male cited on p. 264, *D. corrupta* is not known to occur east of Illinois.

*Aeschna constricta*, *Anax junius*, *Libellula exusta*, *L. quadrimaculata*, *Plathemis trimaculata*, *Diplax corrupta* and *Pachydiplax longipennis* are found on the Pacific coast of North America. *Tramea lacerata* is reported from the Sandwich Is.

The Philadelphia district is at present the northernmost known limit, east of the Allegheny Mountains, of the following ten species: *Hetærina tricolor*, *Argia tibialis*, *A. apicalis*, *A. bipunctulata*, *Gomphus minutus*, *G. plagiatus*, *Gomphæschna* (*furcillata*) *antilope*, *Macromia tæniolata*, *Tramea lacerata* and *Libellula* (*axillena*) *vibrans*. It is the southernmost known limit in the same region of the following five species: *Lestes inequalis*, *Enallagma divagans*, *Gomphus abbreviatus*, *G. villosipes* and *Libellula quadrimaculata*.

### Synonymic Changes Introduced in Part II.

*Gomphæschna antilope* Hag. = var. *furcillata* Say. *Aeschna verticalis* Hag. = var. *juncea* L. *Ae. crenata* Hag. (*eremita* Scud.) = *clepsydra* Say. *Epophthalmia georgina* Selys = ? *Macromia illinoensis* Walsh. *Libellula deplanata* Ramb. = *exusta* Say. *Celithemis amanda* Hag. = *ornata* Ramb. *Diplax assimilata* Uhler = var. *rubicundula* Say.

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## EXPLANATION OF PLATES.

### PLATE II.

Figs. 3–6. Profile views, left side, of the external genital organs on the ventral surface of the second abdominal segment of the males of *Diplax semicincta*, *vicina*, *rubicundula* and *obtrusa*. Seen when the insect is turned upside down. *al* anterior lamina, *ibh* internal and *ebh* external hamular branch, *gl* genital lobe, *vp* vesicle of the penis.

Fig. 7. Labium of imago, ♂ of mature nymph of *Calopteryx maculata*. *sm* submentum, *m* subglossa?, *ml* median lobe, *ll* lateral lobes, *tp* terminal palp, *s* half of mentum?.

Figs. 9, 10. Half of the front portion of labium of very young nymphs of *Anax junius* and *Libellula pulchella*. Letters as before.

Fig. 11. Front view of head of *Gomphus exilis*.

Fig. 12. A nearly horizontal section of the thorax of *Aeschna constricta* showing the wing muscles.

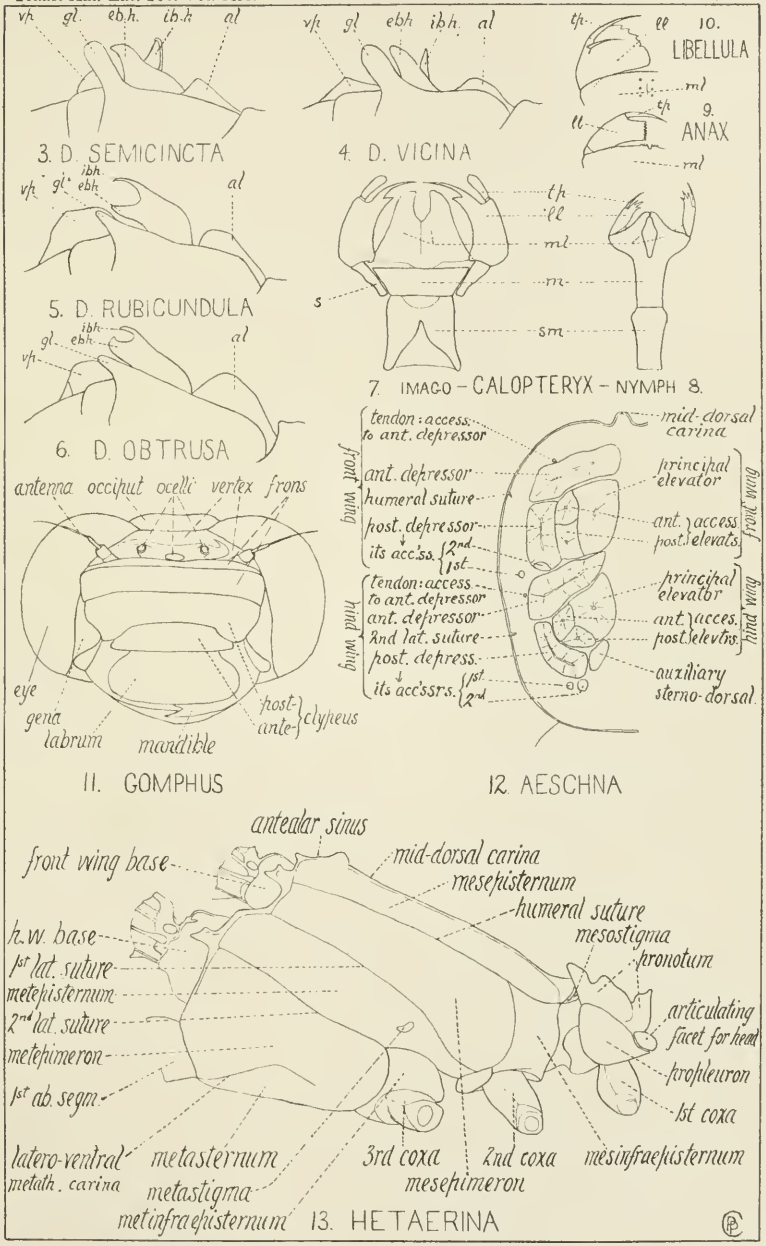
Fig. 13. Right side of the thorax of *Hetærina americana*.

### PLATE III.

Figs. 14–21, 24. Dorsal views of terminal abdominal appendages of the males of various species of *Lestes*. The right superior appendage is omitted.

Figs. 22, 25. Dorsal views of the superior appendages of males of *Enallagma Hageni* and *divagans*.

Figs. 23, 26–32. Profile views right side, of the terminal abdominal appendages of the males of various species of *Enallagma*.


vp gl. eb.h. ib.h al
3. D. SEMICINCTA
vp gl ebh ibh. al
4. D. VICINA
tp ll 10. LIBELLULA
ml
tp 9. ANAX
ll
ml
vp gl ibh. ebh al
5. D. RUBICUNDULA
tp
ll
ml
m
s
sm
7. IMAGO – CALOPTERYX – NYMPH 8.
gl ibh. ebh al
vp
6. D. OBTRUSA
antenna occiput ocelli vertex frons
eye
gena
labrum
mandible
post- ante- clypeus
11. GOMPHUS
tendon: access. to ant. depressor
ant. depressor
humeral suture
post. depressor
its acc'ss. 2nd 1st
tendon: access. to ant. depressor
ant. depressor
2nd lat. suture
post. depress.
its acc'ssrs. 1st 2nd
front wing
hind wing
mid-dorsal carina
principal elevator
ant. post. access elevats.
principal elevator
ant. post. acces. elevtrs.
auxiliary sterno-dorsal
front wing
hind wing
12. AESCHNA
antealar sinus
front wing base
mid-dorsal carina
mesepisternum
humeral suture
mesostigma
pronotum
h.w. base
1st lat. suture
metepisternum
2nd lat. suture
metepimeron
1st ab. segm.
articulating facet for head
propleuron
1st coxa
latero-ventral metath. carina
metasternum
metastigma
metinfraepisternum
3rd coxa
2nd coxa
mesepimeron
mesinfraepisternum
13. HETAERINA

14. L. EURINA

15. L. CONGENER

16 L. UNGUICULATA

17. L. VIGILAX

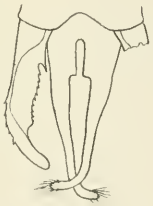
18. L. UNCATA

19 L. DISJUNCTA

20. L. FORCIPATA

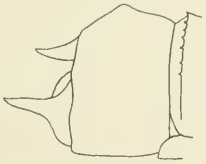
21. L. RECTANGULARIS

22. E. HAGENI



24. L. INEQUALIS

25. E. DIVAGANS



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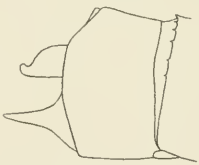

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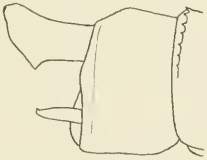
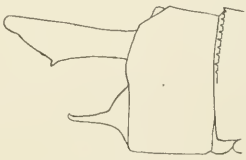
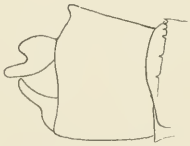


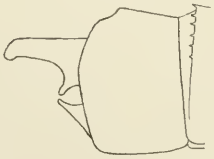
27. E. POLLUTUM



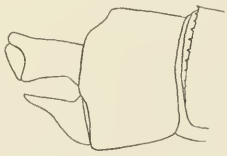
28 E. SIGNATUM



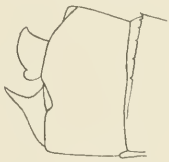
29 E. EXSULANS



30. E. ASPERSUM



31. E. CIVILE



32. E. DURUM

LESTES ENALLAGMA

## Notes on Bees, with Descriptions of New Species.

BY CHARLES ROBERTSON.

**Prosopis floridanus** ♀.—Black, opaque, first segment of abdomen shining; head and thorax densely and finely punctured; metathorax truncate, the disc coarsely reticulated, abdomen impunctate; flagellum testaceous beneath; a spot on clypeus, sometimes wanting, a spot on each side of face, extending half its length above clypeus, two spots on collar, tubercles, a spot on tegulæ, and bases of all the tibiæ, pale yellow; apical joints of tarsi testaceous, base of hind pair whitish; wings hyaline, nervures testaceous, stigma and tegulæ dull, recurrent nervures uniting with transverse nervures, or slightly before them. Length 5 mm.

*Hab.*—Florida; seven specimens ♂ taken in Citrus County.

This species closely resembles *P. affinis* Sm. It is distinguished from that species by its somewhat smaller size, its clearer wings, paler ornaments, by having the spots on the face more elongate and the hind tarsi whitish at base.

**Prosopis flammipes** ♀.—Black; the punctures rather coarse, more dense on head than on mesothorax; metathorax not truncate, enclosure rugose; a triangular spot on each side of face, two spots on collar, and tubercles yellow; first, and base of second segment of abdomen rufous; legs, except bases of anterior and middle pair fulvous; wings except base dusky, stigma and tegulæ black, first and second submarginal cells each receiving a recurrent nervure near its apex. Length 7 mm.

*Hab.*—Florida; one specimen taken in Citrus County.

This species closely resembles *P. nelumbonis* Rob. It is distinguished by darker antennæ and tegulæ, more sparsely punctured mesothorax, and especially by its fulvous legs.

**Andrena crataegi** ♀.—Black, shining; clypeus rather coarsely and sparsely punctured; clothed with short, thin, pale pubescence, on the sides of the face and vertex the pubescence inclines to ochraceous; process of labrum small, triangular, truncate, apex of mandibles rufous; mesonotum and scutellum shining, sparsely punctured, clothed with pale ochraceous pubescence, which is short and thin, except on the sides; metathorax truncate, with long pubescence below, enclosure on the disc strongly rugose, but not enclosed with a salient rim; wings fulvo-hyaline with a strong violaceous reflection, the apex clouded, nervures and stigma testaceous, tegulæ dull; legs with ochraceous pubescence, the tarsal joints within with fulvous pubescence; apical joints of tarsi ferruginous; abdomen shining, rather coarsely punctured, apical margins of segments 2–4 depressed nearly to the middle, the pubescence so short and thin that the abdomen appears bare, except the anal fimbria, which is dull fulvous. Length 10 mm.

♂.—Resembles the female, but the head and thorax are more closely punctured and with the pubescence longer, more dense and more fulvous, the abdomen more sparsely and finely punctured; antennæ long, third and fourth joints subequal; wings paler; sixth ventral segment with a conspicuous reflexed dentiform angle on each side. Length 8–10 mm.

*Hab.*—Illinois; thirty-one female, twenty-three male specimens.

**Calliopsis compositarum** ♀.—Black; opaque; face below antennæ rather sparsely and coarsely punctured, shining; vertex finely and densely punctured; mandibles rufous, labrum shining, truncate; flagellum dull testaceous beneath; pubescence on vertex and thorax above short, griseous, elsewhere thin and pale; mesonotum and scutellum densely and somewhat confluently punctured; wings subhyaline, nervures and tegulæ exteriorly testaceous; legs blackish, anterior and middle knees with a yellowish spot; apical joints of tarsi ferruginous; metanotum with short longitudinal ridges on the disc; abdomen depressed, opaque, except in middle of first segment, where it is shining and impunctate, densely and finely punctured; broad, depressed, apical margins of segments dull testaceous, apical segments subfasciate with very thin whitish pubescence. Length 6 mm.

*Hab.*—Illinois; two specimens.

**Calliopsis solidaginis** ♀.—Black, nearly opaque, clothed with thin, pale pubescence, that on vertex and thorax above inclining to ochraceous; head with rather coarse, sparse punctures, more fine and dense on vertex; mandibles rufous, flagellum testaceous in the middle beneath; mesothorax rather closely and coarsely punctured, slightly shining; disc of metanotum with fine longitudinal ridges; wings subhyaline; nervures, stigma and tegulæ testaceous; legs blackish, anterior and middle knees with a yellow spot, posterior tarsi pale testaceous, apical joint fuscous; abdomen shining, finely punctured, very sparsely on first segment, depressed apical margins dull testaceous. Length 6 mm.

*Hab.*—Illinois; one specimen.

This species is less opaque and less densely punctured than the preceding. It is more densely punctured and less shining than *C. albitarsis* Cr. ♀.

**Nomada bisignata** Say.

In Proc. Ent. Soc. Phil. ii, Mr. Cresson described as new species *N. amœna*, *N. depressa*, *N. maculata*, *N. obliterata*, *N. perplexa*, *N. pygmœa*, and undertook to characterize *N. bisignata* as distinct. Under *N. maculata* he says the variant forms may prove to be varieties of either *americana* Kirby, *valida* Smith, *ruficornis* Linn., or *bisignata* Say. In his "Catalogue of the Described Hymenoptera of America north of Mexico," the above species are referred back as mere varieties of *N. bisignata* Say, and with them are referred *N. americana* Kby. and *valida* Sm. The ornaments of the *bisignata* group are described in great detail, but, on account of the failure to discover certain structural characters, the effort to separate the species has proved hopeless, and the accumulation of specimens has seemed to prove that the forms are only varieties. I am not prepared to pass upon all of the originally proposed new species, but give the results of my study of the group as based upon specimens taken by myself in my own neighborhood (Carlinville, Ill.).

Mandibles bidentate ..... **N. maculata.**
Mandibles simple.
Fourth joint of antennæ nearly twice as long as third, seen from beneath, ♀ abdomen 7-spotted..... **N. cressonii.**
Fourth joint of antennæ hardly longer than third.
Last abdominal segment of ♂ bifid, abdomen of ♀ 4-spotted..... **N. sayi.**
Last abdominal segment of ♂ entire, abdomen of ♀ 7-spotted. **N. integra.**
Male unknown, abdomen of ♀ not spotted..... **N. incerta.**

**Nomada maculata** Cr. ♀.—Mandibles bidentate, fourth joint of antennæ little longer than third or fifth; head and thorax densely and coarsely punctured, abdomen shining, rather sparsely and finely punctured; ferruginous, apex of mandibles, about the base of the antennæ, about ocelli, cheeks behind, line in middle of mesonotum, broader line on metathorax, bases of coxæ, and sutures of thorax generally, bases of femora, hind tibiæ within, hind metatarsi, base of abdomen and apical margins of segments above and beneath, more or less black or fuscous; wings dusky, with usual pale lunule, nervures blackish, stigma dull ferruginous, tegulæ pale ferruginous, spot on each side of segments 1–5 yellow, those on last two segments small and rounded, or wanting, or, as in one specimen, only a small spot on each side of second. Length 7–8 mm.

♂.—Antennal joints and mandibles as in female, head black, mandibles, except tips, clypeus, inferior orbits extending narrowly on sides of face as high as insertion of antennæ yellow, scape dull yellow beneath, flagellum pale ferruginous, with a fuscous line above more marked towards base; spot at summit of eyes, sometimes wanting, ferruginous or yellow; thorax black, line on collar more or less interrupted, tubercles and tegulæ ferruginous or yellow; mesonotum black, sometimes with two or four longitudinal ferruginous lines, scutellum entirely black or ferruginous, or with two ferruginous or yellow spots, post-scutellum black, ferruginous or yellow; pleura black, sometimes with a large yellow or ferruginous spot below, with or without a small ferruginous spot above it; wings hyaline, apical margins clouded; legs ferruginous, sometimes varied with yellow, femora more or less black at base beneath, especially the posterior pair, hind tibiæ sometimes fuscous within; abdomen ferruginous; base, basal and sometimes apical margins of segments fuscous, band or two spots on first segment, often wanting, and transverse bands on remaining segments, more or less interrupted on the disc, yellow, apical segment bifid. Length 6–8 mm.

*Hab.*—Illinois; fourteen female, thirty-two male specimens.

**Nomada cressonii** ♀.—Mandibles simple; fourth joint of antennæ nearly twice as long as third; dull ferruginous, antennæ fuscous above, apex of mandibles, about antennæ and ocelli, cheeks posteriorly, sutures of thorax, median stripe on mesonotum and on metathorax, broad band from wings to middle coxæ, bases of femora and hind metatarsi, base of abdomen and apical margins of segments black or fuscous; wings hyaline, marginal cell and apical margins clouded; abdomen finely punctured, segments 2–3 with a spot on each side, fourth with two spots on each disc, fifth with transverse spot, all yellow. Length 8–9 mm.

♂.—Resembles the female; face below antennæ, labrum, mandibles except tips, scape beneath and inferior orbits yellow; superior orbits ferruginous, flagellum ferruginous, with a fuscous line above; mesothorax mainly ferruginous with

black markings; metathorax black; anterior legs yellow, especially at the knees posterior pairs ferruginous, femora at base beneath, more extensively on posterior pairs, and hind metatarsi blackish; abdomen ferruginous, black at base; spots on each side of segments 1–5, often wanting on first and united on fifth, yellow, sixth segment with a transverse spot, apical segment bifid. Length 7–9 mm.

*Hab.*—Illinois; four female, six male specimens. This is the var. *b* of Cresson's *N. maculata*.

**Nomada integra** ♀.—This species closely resembles the preceding, but is distinguished by its antennæ having the fourth joint no longer than the third, by its smaller size, the ferruginous color more pale, wings more faintly dusky at tips; abdomen with ornaments the same, but the spots pale yellowish, or whitish. Length 7 mm.

♂.—Apical segment of abdomen entire; head black, apex of clypeus, inferior orbits, scape beneath, mandibles, except tips, yellow; flagellum pale ferruginous, with a fuscous line above, wings faintly dusky at tips; thorax black, tubercles and tegulæ exteriorly yellow, sometimes two spots on scutellum yellow or ferruginous, anterior legs pale ferruginous, hind femora as usual largely black; abdomen pale ferruginous, black at base, segments 2–5 with whitish spots on each side, sometimes the spots are wanting, except on second and third, sixth with a transverse spot. Length 6–7 mm.

*Hab.*—Illinois; one female, eight male specimens. This is easily distinguished by its small size, equal joints of flagellum, whitish ornaments and entire apical segment of male.

**Nomada sayi** ♀.—Mandibles simple, third joint of antennæ shorter than fourth; color ferruginous with the usual black marks characteristic of the group; segments 2 and 3 of abdomen with a rounded yellow spot on each side and sometimes two small spots on fifth segment. Length 5–7 mm.

♂.—Resembles the female; apex of clypeus, inferior orbits, mandibles except tips, and labrum yellow; scape beneath and flagellum except line towards base above pale ferruginous, scape sometimes yellow beneath; thorax black, tubercles and tegulæ pale ferruginous; prothorax black, or with two ferruginous spots; scutellum black, or sometimes with two ferruginous spots; legs pale ferruginous, hind femora largely black; abdomen, except base, ferruginous, segments 2 and 3 each with a yellow spot on each side, sometimes a small spot on each side of 4 and 5 and a transverse spot on 6, apical segment bifid. Length 5–6 mm.

*Hab.*—Illinois; eight female, fifteen male specimens. This species may be distinguished from the preceding by its smaller size, the 4-spotted abdomen of female and the bifid apical segment of the abdomen of the male.

**Osmia conjunctoides** ♂.—This species closely resembles the male of *O. conjuncta* Cr. (= *O. 4-dentata* Cr. ♂). It is about the same size, but perhaps a little longer; the same punctuation, also the two tubercles, one above the other, just above the insertion of the antennæ; the color more bluish or purplish; the sixth segment with lateral teeth, which instead of being acute as in *O. conjuncta* ♂, are broad and obtuse and produced downwards; the middle lobe of this segment more reflexed or carinate, truncate and slightly emarginate, or rounded, apical segment as in *O. conjuncta*. Length 8–9 mm.

*Hab.*—Florida; five males taken in Citrus County.

## Notes and Descriptions of Pselaphidæ, with Remarks on the Scydmænidæ.

BY E. BRENDEL, M.D.

Mons. Achille Raffray took for a diagnostical base of the genera of the tribe Tyrini the length of the last joint of the maxillary palpi, which necessitated the establishment of quite a number of genera consisting, until now, of a single species. *Pytna* Casey and *Tyrus* do not differ by any other property. *Hamotus* and *Cercocerus*, aside from the different form of the antennæ, are differentiated by the length of that last palpal joint which separates *Upoluna* from *Cercocerus*, and takes *Hamotus elongatus* (*Tyrus elongatus* Brendel) from *Hamotus*, making a *Cercocerus*. I hope future discoveries will bring on a justification one way or the other.

**Tychus ludovicianus** n. sp.—Form and color of *T. longipalpus* Lec. and somewhat larger; pubescence not long, sparse. Length 1.9 mm. Head and prothorax like *T. longipalpus*. Elytra more convex; antennal joints rounded, visibly longer than wide, fifth perceptibly larger, eighth as long as wide, ninth and tenth transverse; the ♂ anterior trochanters, near the coxal articulation, are armed with a small conspicuous thorn; metasternum tumorous in the middle before the posterior coxæ, the tumor is divided posteriorly by a wide prismatic groove, the two parts crowned by a large mastoid sharp thorn; first ventral with a deep digital impression, the last with a deep circular fovea near the apex. the posterior coxæ mutually as distant as the width of the capital front; the third palpi joint as long as the last, the inner edge not angulate as the *T. longipalpus* from Ohio, Illinois and Missouri, which latter has the metasternal tumor not armed, and the antennal joints not rounded, but oblong-conical.

Louisiana, Mississippi near the Gulf shore (Hugo Soltau).

**Tychus microphthalmus** n. sp.—Unicolorous brown, coarsely, not densely pubescent, impunctate. Length 1.4 mm. ♂.—Form like *T. puperulus*. Head on the eyeline as wide as long, vertex but slightly convex, transversely, longitudinally straight and the supraantennal tubercles but little elevated; eyes very far below the vertex, consisting of about eight facettes; antennæ longer than the head and prothorax; palpi of the form of those of *T. cognatus;* the base of the pronotum with five or seven very small punctures; anterior trochanters with a very strong, curved spine.

Cañon City, Col. (Wickham) The female is not known, and is perhaps without any eyes.

*Pselaptrichus* belongs to the *Bythinus* group, and should be placed between *Tychus* and *Machærites*. A change of the name *Machærites* (from *μαχαιρα* a knife) into *Machærodes* is unnecessary, as the tubercles of the second palpal joint are absent in some European species, and present in our *M. tychoides*.

The names *Anops* and *Typhloops* being preoccupied, and *Eusanops*, proposed by Capt. Casey, means only "nearly blind," I forged, by hard labor, the euphonic name *Arianops* (Pl. IV, fig. 3), from ἀρι "very," ἀν "without," ὤπς "eye."

**Decarthron marinum** n. sp.—Form like *D. Brendeli*, impunctate, pubescence white, moderately long, thinly distributed. Length 1.7 mm.

The males differ from *D. Brendeli* (Pl. IV, fig. 6) by having the antennæ not modified and the distal third of the intermediate femora simply compressed, forming a sharp ridge above, but no tubercle or spine as in *D. exactum*. From *D. abnorme* it differs in the whole form,

Golfview, Miss.; New Orleans, La. (Hugo Soltau).

**Decarthron scarificatum** n. sp.—Has the form of *D. stigmosum*. Length 1.7 mm. Head with two large foveæ on the eye-line, twice as far apart as either from the eye; two small punctures between the frontal tubercles, connected with the occipital foveæ by a straight, faintly impressed line; prothorax sculptured with parallel longitudinal scars of equal length, each scar about four times longer than wide, fusiform, the base garnitured with a row of sharp punctures; elytral lines entire, abdominal basal carina, including half the width, appear as a continuation of the discal lines of the elytra.

Iowa, Cedar Rapids.

**Decarthron seriepunctatum** n. sp. Length 1.2 mm. ♂. Form, size and color of *D. formiceti*, but the head has the occipital foveæ very large, the frontal depression quite obsolete, the prothorax is less circular, widest rather behind the middle, the base wider and neck narrower; the elytra are visibly punctate in longitudinal rows, which are plainer on and near the sutural lines and on the lateral declivities; the pubescence is rather long and abundant; antennal joints decreasing in size from the base to the middle and thence increasing; the intermediate femur is not inflated as in *D. formiceti*, and as it is gauged from the middle, it does not present that enormous spine of *D. formiceti*, but simply two tubercles.

Tennessee, H. Ulke.

**Bryaxis foveata** Lec.—Red-brown, elytra and legs brighter, impunctate, pubescence very fine. Length 1.45 mm. Head large, frontal ridge angular, interantennal space depressed, fovea circular; pubescent and equal in size to the occipital foveæ; antennæ slender, joint 1 cylindrical, twice as long as wide, 2 as wide as 1, and one-half longer than wide, the following ones much narrower, 3 and 5 twice as long as wide; 4 and 6 shorter, 7 still shorter; 8 as long as wide, 9 and 10 trapezoidal, increasing in width and length; prothorax wider than long, all foveæ very large, pubescent, and fully seen from above; elytra confusedly faintly punctulate; abdomen ♂ with the first dorsal one-third as long as wide, the carinæ including one-half of the surface within the border, the middle of the posterior end raised from the base of the second, so as to form a triangular opening; the second segment not produced as in *B. Belfragei*, but similarly transversely depressed at its base; the third is not modified; the posterior tibiæ are not dilated.

Salt Lake, Utah.

*Bryaxis Belfragei* Lec. has the second dorsal segment of the male excavated or depressed; the depression, deepest at the base, takes in half the width of the segment, arcuate, indefinitely limited and shallow, and in the middle of the depression there is a carina rising from a small bilobed basal elevation.

**Bryaxis cylindrartus** n. sp. ♂.—Piceous black, impunctate, thinly pubescent, elytra dark red; antennæ, palpi and legs brown. Length 1.4 mm. Head with three equidistant, equal, large, spongipubescent foveæ, not more distant mutually than their diameter; prothorax wider than the head, convex, lateral foveæ not larger than those on the vertex, circular not fully seen from above, median fovea very small; the base twice as broad as the neck; elytra rather convex, thinly and minutely punctulate, shoulder width not exceeding the width of the prothorax, tip twice as wide as the base of the prothorax; discal lines very long, convergent; first abdominal dorsal segment two-fifths as long as its width, with long divergent, at the base closely approximate carinæ; antennæ (Pl. IV, fig. 18) nearly as long as the head, prothorax and elytra together, all the joints cylindrical, none less than twice longer than wide, the fifth three times longer, the last as wide as the first, three times longer, and as long as the three penultimate together; the middle tibiæ spurred before the tip, and the coxæ armed with a curved thorn.

North Illinois. The ♀ I have associated with this species.

*Bryaxis facilis* Casey, according to the author's testimony by kindly naming a specimen for me, is nearly related to *B. divergens*, from which it differs by being narrower across the shoulders and the elytra impunctate.

**Bryaxis depressifrons** n. sp.—Piceous black, impunctate, pubescence short, sparse, elytra red, with a dark brown basal fascia at the humeral calluses; legs, antennæ and palpi red. Length 1.3 mm. Head (Pl. IV, fig. 17) from the mouth to the base longer than wide, prognathous, from the base to the frontal declivity one-half as long as the head is wide, eyes included; the front trilobed or deeply bisinuate; the lobes elevated, leaving two furrows, each of them connecting the large occipital foveæ, which are nearer to the declivity than to the base, the larger medial elevation connects the occiput with the frontal declivity, the lateral elevation punctured, the declivity perpendicular, bearing at its bottom a transverse oval pubescent spot like *B. compar;* clypeus and labrum simple and nearly horizontal; antennæ with the first and second joint as thick as the last joint, eighth, ninth and tenth trapezoidal, very transverse, the intermediate globular or obconical in the third and fourth, about half as wide as the second; elytral discal lines convergent, the abdominal basal carinæ short, including one-third of the segmental width.

California, Alameda County (Chas. Fuchs). Three females, which ought not to be described, but their peculiarities which might lead to the discovery of the males.

*Bryaxis compar* Lec. is identical with *B. franciscana* Casey (*teste* Casey).

**Bryaxis Wickhami** n. sp.—Unicolorous, ferruginous, impunctate. Length 1.4 mm. Head, frontal margin triangularly produced, bearing the circular pubescent fovea, which is equal with and less distant from the occipital foveæ as the latter are mutually; antennæ ♂ (Pl. IV, fig. 19) longer than the head and prothorax, joints 1 and 2 equal, obconical, large, third and fourth very small, globular, as large as the seventh or eighth; the fifth largest, longer than wide, as thick as the last joint, with a perforate large fovea underneath, truncate at the tip, the sixth in form and size equal to the second; ninth and tenth obconical, longer than wide, not quite as strong as the sixth; the last as long as the ninth and tenth togther ovate acuminate; prothorax very convex, the foveæ not fully to be seen from above; elytra with a subhumeral fovea on the declive side, slightly elongated backwards; abdominal carinæ including one-third of the segmental width.

♀.—Antennæ not longer than the head and prothorax, the fifth and sixth are not as large, and the third, fourth, seventh and eighth not as small as in the ♂; the fovea of the fifth joint, however, is present, though a very small puncture.

From Cañon City, Col., discovered by H. F. Wickham.

**Batrisus sinuatifrons** n. sp.—Brown, elytra and legs red, tarsi and palpi yellow. Length 1.8 mm. Head orthognathous, vertex as long as wide, quadrate, sides parallel, edge extremely finely carinate, front broadly arcuate; disc scabrous, with two small nude punctures in the eye-line, mutually four times as distant as either from the eye; no circumambient sulcus; front (Pl. IV, fig. 5) declive anterior to the antennal line, the short declive part bisinuate, leaving in the middle a black, shining, sharp-pointed tubercle, and at each side a pendant, cylindrical, squarely truncated peg, crowned with short yellow hair; the clypeus rises from the labial base as a straight column crowned by two divergent tufts of hair, the lateral wings are edged and gradually more reflexed towards the upper lateral angle, which is turned straight forward, appearing from a side-view as a sharp horizontal spine; antennæ, joint 1 cylindrical, curved, three times longer than wide; 2 not much narrower oval, 3–8 equal in width, gradually shorter, 5 little stronger, 8 transverse, 9 transverse, wider, 10 twice as wide as 8, globose, the underside with the basal half sharply excavate, 11 not thicker ovate-acuminate; prothorax trisulcate, trifoveate, basal thorns large, sharp, continued anteriorly and posteriorly by short carinæ, in the middle between the base and the medial fovea is a distingued carinæ; disc impunctate; elytra broad shouldered, the lateral callus not armed, on the declive sides a conspicuously impressed line rising from a subhumeral fovea; last palpal joint meniscus-shaped.

♀.—Clypeus faintly trilobed, continuous with the front, tenth antennal joint small.

Memphis, Tenn. (Hugo Soltau).

**Batrisus clypeonotus** n. sp.—Dark umber-brown elytra; legs, palpi and club of the antennæ red. Length 2.2 mm. ♂. Head prognathous, vertex quadrate, not arched in front, sides parallel edged, fovea small, nude, widely distant, grooves not deep, not connected in front, disc punctate, roof-shaped and carinate in the middle, margin densely punctate; frontal margin (Pl. IV, fig. 4) on the declivity broadly arcuately bilobed; in the middle of the interantennal excavation are to be seen two black teeth, rather far apart; clypeus slightly

carinate in the middle of the rather broad tubercle, crowned with the usual two pencils of yellow hair, lateral upper angle of the wings largely reflexed, forming a three-edged pyramid, curved forward, one edge is formed by the lateral edge, the other by the upper edge of the clypeus, the third runs at the outside backwards to the base of the antennæ; labrum emarginate, granulate; antennæ: joint 1 twice as long as wide, flattened above, the flat surface divided longitudinally in an upper part smooth, shining, and a lower part granulated; 2-3 cylindrical, slightly narrower at their bases, 8 transverse, 9 oval or thickly lenticular, 10 globose, not foveate, 11 not as thick as the tenth, ovate acuminate, not longer than the ninth and tenth together; prothorax trisulcate, bicarinate from the middle to the tubercle, which is large acuminate and carinate anteriorly and posteriorly, the middle of the base carinate: elytra punctate, base trifoveate, humeral callus acute; first dorsal segment one-third as long as its width, basal impressions deep, carinulæ one-fifth apart; posterior tibiæ with a thick spur near the tip inside.

Ponchatoula, La.; a single specimen (Hugo Soltau).

**Trimioplectus? parabolicus** n. sp. (Pl. IV, fig. 7)—Brownish yellow pubescence fine, dense, not as convex as *T. obsoletus*. Head wider than long, antennal tubercles prominent channeled, sulcus broadly parabolic connecting the pubescent foveæ, base angularly impressed, but neither sulcate nor carinate, neck rather thick; palpi small, hardly longer than the second antennal joint; antennæ: joint 1 rather short, 2 obovoidal large, 3-7 small globular, 8 slightly transverse, 9 as long as 8, and three times wider, 10 longer, and three times wider, 11 wider ovate; prothorax wider than long, lateral foveæ seen from above, connecting sulcus, angulated in the middle, base minutely punctured; elytra nearly quadrate, the sutural basal punctures not farther apart than the lines; discal foveæ deep, with a short elongation as long as one-fifth of the elytral length; dorsal segments all nearly equal in length, base not carinate; ventrals, the second but little longer than the third; legs: the anterior thighs stronger, middle trochanter armed with a conical thorn.

This is a doubtful member of the genus *Trimioplectus*, and does not compare more favorably with any other genus.

**Euplectus elongatus** n. sp.—Form and sculpture resembling *Euplectus confluens*, but more robust. Length 1.4 mm. Head of the male shorter, more transverse, no frontal transverse sulcus as in *E. confluens*, otherwise like it in sculpture; prothorax nearly as wide as the head, much wider than in *confluens*, impunctate, widest in the anterior third, where it is more angularly rounded than *E. confluens*, and therefore appearing more transverse; elytra impunctate, sutural lines arcuate, discal lines reaching to half the length of the elytron; abdomen narrower than the elytra, side parallel, impunctate; ventral ♂ sexual marks differ from *E. confluens*, having the fifth ventral not modified, the sixth or penultimate deeply foveate in the middle, the last lozen-shaped and carinate.

From Chestnut Ridge, Pa. (Jerome Schmitt).

I consider this species, with *E. confluens* and *californicus*, as climatical races of Pennsylvania, Illinois and California.

**Rhexius Schmitti** n. sp.—Ferruginous yellow, impunctate, pubescence fine, more recumbent. Length 1.3 mm. Head more convex, the occiput carinate

in the middle, not sharply edged at the posterior declivity, the frontal margin transversely depressed and broadly angulate in front; prothorax (Pl. IV, fig. 20) with the sides slightly sinuate and mutually convergent in an angle of 72° anteriorly, in the middle arcuate and nearly straight thence to the base, which latter is as wide as the length of the prothorax; the fovea and grooves as in *R. insculptus;* elytra with a basal elevated margin, 4 puncture and indications of four lines, the third the longest.

Discovered by P. Jerome Schmitt in Pennsylvania (Henry Ulke, ibidem).

Our species of *Faronus*, from the Pacific coast, Sharp and Raffray declare identical with *Sagola* Sharp; and *Sonoma cavifrons* Casey identical with *Sagola parviceps* Mäklin. They seem to be widely distributed from Alaska (from whence I have the largest specimen, which is as long as *F. tolulæ* Lec.) to San Francisco. Our *Faronus tolulæ*, considered by LeConte a doubtful *Faronus*, seems to be neither *Sagola* nor *Faronus*, and will be investigated by M. A. Raffray.

*Euplectus rufipes* Lec. (Pl. IV, fig. 9) is said to be a convex form. The figure of a specimen from Iowa agrees with Casey's description, but is a true *Euplectus*, not resembling a *Trimium*. Which is the true form?

"*Aenisis* (*Desimia*) *dispar* Sharp, described in the Biologia Centrali-Americana, was discovered by my friend, Mr. A. Bolter, in Arizona."

*Remarks on the Scydmænidæ.*

*Scydmænus gracilis* Lec. is not a *Scydmænus*, neither is it a *Chevrolatia*. There is nothing known to me with which it can be united.

**Eumicrus Caseyi** n. sp.—Form similar to *Cholerus Zimmermanni*, slender, yellowish brown, polished, impunctate, pubescence abundant, not dense. Length of ♂ 1.1 mm., of ♀ 1.4 mm. Head trapezeous, widest across the frontal quarter, where the outlines are shortly arcuate, nearly straight and convergent to the neck, the sides rounded, not edged, disc broadly convex, without any impression. Eyes on the sides of the front, in ♂, as large as the second antennal joint, very flat, of a brown color (nyctalopic), not seen from above; in ♀ less than one-third as large as in ♂ and hardly perceptible. Antennæ at the base nearly contiguous, separated by a very narrow septum; 1st joint cylindrical, four times as long as wide; 2d oval, as wide as 1st; 3–8 globular, equal; 9th nearly twice as wide and little longer than the 8th; 10th larger than 9th, and of the same form; 11th as long as 9th and 10th together, ovate on third longer than wide. Prothorax as long as wide, seemingly longer, widest one-third from the neck; neck one-half as wide as the base, lateral outlines arcuate anteriorly, slightly sinuate posteriorly, hind angles rectangular; disc very convex, sides rounded, near the middle of the base on each side a sharp puncture and a transverse, very faintly impressed line (in ♂ more perceptible), connecting the puncture with a very shallow

lateral impression. Elytra widest in the middle, and one and two-thirds longer than wide, shoulders high, prominent, their width as wide as the prothorax, tip rounded, very broadly arcuate, nearly truncate. Pygidium triangular: mesothorax carinate; first ventral twice as long as the second, the last longer and convex in the ♀, short and concave in ♂.

Pennsylvania.

As a slight return of favors received this is named in honor of Capt. T. L. Casey.

**Scydmænus? ovithorax** n. sp. (Pl. IV, fig. 12).—Brown, impunctate, thinly pubescent. Length 0.8 mm. Head three-fourths width of prothorax, nearly quadrate, the frontal margin tripartite by short impressed lines, declive anteriorly. Eyes brown (nyctalopical) very flat and small on the anterior part of the sides and hardly to be discerned; antennal club 3-jointed. Prothorax obovate, without any impressions and rounded sides. Elytra together elliptical, shoulders obsolete, faintly depressed at the middle of the base of each elytron; sutural lines faintly indicated at the basal fourth, the posterior part seems to be connate (wingless?); anterior coxæ contiguous, posterior coxæ small, mutually remote, femnrs clavate, pedunculate, compressed; ventral segment six, the last very large, as long as the three preceding ones together.

California, Santa Clara County. Ch. Fuchs.

Like *Scyd. minimus* (Pl. IV, fig. 13), this is a very doubtful *Scydmænus*, but I prefer to leave it there until similar forms are discovered.

*Brachycepsis*, of which I described *B. Fuchsii* (Pl. IV, fig. 11) includes all Scydmæni with "collum imersum thorace" of LeConte's Synopsis and (*teste* Dr. Sharp) ought be retained in that new genus.

### EUTHIA Stephens.

Until the present day the genus *Euthia* was never discovered in the United States of America. Our present species of the genus *Euthiodes*, supposed to be *Euthia*, differ in the form of the maxillary palpus, the third and fourth joint being united to a thick fusiform body sharply pointed, the antennæ strongly geniculate, the posterior coxæ mutually very moderately distant. Common with *Euthia* is the general form with the head short, pronotum arcuate, quadrate, edged on the sides, elytra finely margined, truncate or not covering the pygidium. The species known, according to LeConte's Synopsis, are:

Elytra distinctly punctured, prothorax as wide as long, with five basal punctures. Length 1.0 mm. (Arizona)..... **colon** Horn.

Elytra faintly punctured, vertex foveate.

Prothorax wider than long, with an abbreviated basal line. Length 1.1 mm. (Alaska, Oregon)..... **scitula** Mäklin.

Prothorax as long as wide, basal line entire, connecting three punctures (California)..... **impressa.**

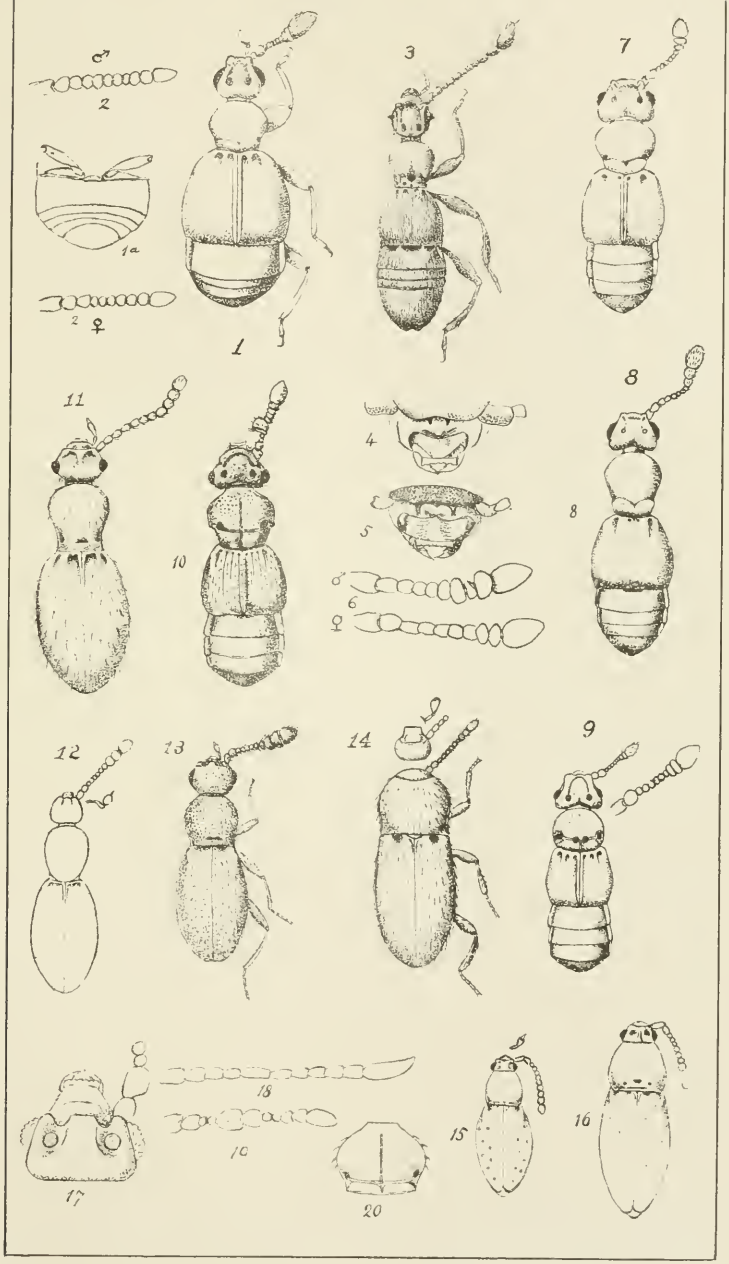
Prothorax longer than wide, basal line connecting five punctures (California). **longula** Lec.

There are two specimens before me said to be *E. scitula* from Pennsylvania and *colon* from Iowa, which do not agree with the above descriptions. *Euthiodes lata* n. sp. (Pl. IV, fig. 15) the supposed *colon*, is coarsely, faintly and sparsely punctured at the sides of the elytra, otherwise impunctate; the vertex without impressions; the pronotum with median basal punctures, a longitudinally elongate fovea next to the posterior angle and between it and the medial one two confluent punctures; elytra one and one-half times longer than wide.

The supposed *E. scitula* (*Euthiodes cristata* n. sp.) (Pl. IV, fig. 16) is extremely fine and sparsely punctulate and 0.66 mm. long; the head is carinate in the middle, on either side of the carina impressed; the pronotum has an abbreviated basal line, a transverse, conspicuous fovea one-fifth of the length of the disc from the base, on either side in the middle between the medial and the anteriorly prolonged lateral fovea is a deep puncture; the basal corners are explanate. Length 1.2 mm. Pennsylvania (Jerome Schmitt, H. Ulke).

## EXPLANATION OF PLATE IV.

Fig. 1.—*Eupsenius glaber*, long. 1 mm.
" 1*a*.—Venter of same.
" 2.—Antennæ ♂ and ♀ *Atinus monilicornis*.
" 3.—*Arianops amblyoponicus*, long. 3.4 mm.
" 4.—Face of *Batrisus clypeonotus*.
" 5.—Face of *Batrisus sinuatifrons*.
" 6.—Antennæ ♂ and ♀ *Decarthron Brendelii*.
" 7.—*Trimioplectus parabolicus*.
" 8.—*Trimioplectus obsoletus*, long. 1.2 mm.
" 9.—*Euplectus rufipes*, long. 0.6 mm.
" 10.—*Rhexidius trogasteroides*, long. 2 mm.
" 11.—*Brachycepsis Fuchsii*, long. 1 mm.
" 12.—*Scydmæus (?) ovithorax*, long. 0.8 mm.
" 13.—*Scydmæus (?) minimus*, long. 0-5 mm.
" 14.—*Cephennium anophthalmicum*, long. 1 mm.
" 15.—*Euthiodes lata*, long. 0.66 mm.
" 16.—*Euthiodes cristata*, long. 1.1 mm.
" 17.—Head of *Bryaxis depressifrons*.
" 18.—Antenna of *Bryaxis cylindrartus*.
" 19.—Antenna of *Bryaxis Wickhami*.
" 20.—Prothorax of *Rhexius Schmitti*.


♂
2
1a
2 ♀
1
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## A Synopsis of the Harvest-Spiders (Phalangiidæ) of South Dakota.

BY CLARENCE M. WEED.

I am indebted to Messrs. J. M. Aldrich and T. A. Williams for an interesting collection of harvest-spiders from certain points in South Dakota, chiefly Brookings and Custer. These specimens on the whole are peculiar, because of the shortness of the legs and the tendency to melanism. Possibly the former may be due to the fact that in a prairie country long legs are less useful than in a wooded region; this seems especially likely, in view of the fact that, while out-door forms have very short legs, *P. cinereum*, which lives in sheds and about houses, has legs of normal length.

With the exception of the male *Trachyrhinus favosus* and *Liobunum (?) calcar*, the measurements given below are from South Dakota specimens.

### Family PHALANGIIDÆ.

Teguments soft or coriaceous. Five or six ventral segments; the first very large and prolonged cephalad between the coxæ. Anal piece unique or accompanied by two small lateral pieces. Two eyes situated upon a tubercle, always separated from the anterior border. Two transverse striæ on the cephalothorax back of the eye-eminence. Lateral borders of coxæ free; maxillary lobe of second pair always visible. Palpi elongate; tarsus longer than tibia, terminated by a claw. Legs similar to each other; tarsi multi-articulate (Simon).

Two subfamilies are represented in the collections at hand. They may be distinguished as follows:

Body very hard and greatly roughened by reticulations or tubercles.
**Mesosomatinæ.**

Body soft or subcoriaceous, not much roughened by reticulations or tubercles.
**Phalangiinæ.**

### Subfamily MESOSOMATINÆ.

Body very hard, most of the dorsal segments being united in a firm, dense plate; much roughened by tubercles or reticulations. In the males the posterior dorsal and the ventral abdominal segments

have their margins developed into thin overlapping plates. Pores on margin of cephalothorax distinct. Anal piece unique; maxillary lobe of palpi with two tubercles.

The two genera of this subfamily are easily separated by the following characters:

Fourth legs as long as second legs, or nearly so.....**Mesosoma.**
Fourth legs distinctly shorter than second legs.....**Trachyrhinus.**

**MESOSOMA** Weed, 1892.

Dorsum a firm hard plate, thickly studded with small, hemispherical tubercles. Eye-eminence of nearly equal height, length and breadth; not carinated. Palpi moderately robust, not branched, and furnished with many tubercles; claw pectinate; tooth on underside of first joint of mandibles. Legs short, coriaceous, robust; second and fourth pairs of nearly equal length; lateral pores on upper margin of cephalothorax distinct, subcircular.

**Mesosoma nigrum** (Say) Weed. Plate V.

*Phalangium nigrum* Say, Journ. Phila. Acad. vi, p. 66, Compl. Writings, ii, p. 14. Wood, Comm. Essex Inst. vi, p. 34.

*Astrobunus (?) nigrum*, Weed, Amer. Nat. vol. xiv, p. 917.

*Mesosoma nigrum*, Weed, Amer. Nat. xxvi, 529.

*Male.*—Body 6 mm. long.; 4 mm. wide; palpi 4 mm. long. Legs: first, 10 mm.; second, 17 mm.; third, 11 mm.; fourth, 16 mm. Black; ventrum of cephalothorax including coxæ, trochanters and base of femora, brown. In some specimens the apical portion of the legs, and more or less of the ground color of the dorsum is brownish black. Dorsum thickly studed with small hemispherical black granules or tubercles. Segmentation of abdominal scutum indicated by faint impressed lines. Eye-eminence longer than high, not canaliculate; covered with black tubercles like those on the dorsum. Palpi black, all the joints slightly arched, robust, with none of the angles prolonged; furnished with more or less scattered black tubercles and spinose hairs; mandibles blackish. Legs short, robust, granulate; ventral surface of abdomen blackish brown, granulate. Genital organ of male "slender, proximally subcylindrical, then flattened and slightly expanded into a broad, somewhat circular, very thin, alate portion, then suddenly contracted and bent at an obtuse angle, ending in a very fine point."

*Female.*—Body 2 mm. long; 5 mm. wide. Palpi 4.5 mm. Legs: first, 10 mm.; second, 17 mm.; third, 11 mm.; fourth, 16 mm. Besides its larger size it differs from the male in having less black on the ventral surface, which is cinnamon-rufous, spotted with black; mandibles brown, black above, and the outer margins of the dorsum of the abdomen smooth without the black tubercles which form a large distinct quadrangular plate on the middle of the abdomen, and a transverse plate on each of the three posterior segments. The smooth margins are brown.

Described from many specimens.

Brookings. This remarkable species seems to be rather common in South Dakota.

**TRACHYRHINUS** Weed, 1892.

Body very hard; dorsum a large plate, with a rough, coarsely punctate surface. Front margin of cephalothorax furnished with two denticulate tubercles. Eye-eminence prominent, with two rows of large tubercles having spinose tips. Legs rather long, thickly beset with spinose tubercles. Pores on margin of cephalothorax rather small, oval; palpal claw smooth; inner distal angle of femur very slightly and of patella quite strongly developed. First joint of mandible furnished with a tooth on lower surface. Second legs decidedly longer than fourth.

**Trachyrhinus favosus** (Wood) Weed.

*Phalangium favosum* Wood, Comm. Essex Institute, vol. vi, pp. 28-29.
*Astrobunus* (?) *favosum* (Wood). Weed, Amer. Nat. vol. xxiv, p. 917.
*Trachyrhinus favosus* (Wood). Weed, Amer. Nat. vol. xxvi, p. 529; Trans. Am. Ent. Soc. xix, 193, pl. 10.

*Male.*—Body 7 mm. long; 5 mm. wide. Legs: first, 21 mm.; second, 40 mm. third, 21 mm.; fourth, 26 mm. Body and members black, more or less mottled with gray; body very hard, dorsum nearly square and quite level, having projecting angles on the anterior lateral corners; grayish, spotted with black, and a faint central marking; coarsely punctate "so as to have a worm-eaten, almost honey-combed appearance." Eye-eminence slender, rather high, light brown, with several robust acute spines, which are at their bases gray, but are tipped with black. Palpi roughened with numerous small blackish spines and spinose hairs; inner distal angle prolonged in a pointed, conical protuberance. Legs stout, thickly beset with spines.

*Female.*—Body 7 mm. long; 4.5 mm. wide; palpi 4 mm. long. Legs: i, 18 mm.; ii, 32 mm.; iii, 17 mm.; iv, 25 mm. Similar to male.

A very peculiar and rather common species. Brookings.

## Subfamily PHALANGIINÆ.

Teguments soft or subcoriaceous, not greatly roughened. Segments indicated by striæ, which are often obsolete. Five ventral segments; a single anal piece; two lateral pores easily seen; maxillary lobe of palpus with two tubercles.

The two genera occurring in South Dakota are distinguishable by the character mentioned below.

A tooth on ventral surface of first joint of mandibles.....**Liobunum.**
No tooth on ventral surface of first joint of mandible.....**Phalangium.**

**LIOBUNUM** C. Koch, 1839.

This genus is defined by Simon practically as follows: Teguments soft or subcoriaceous. Striæ of the cephalothorax and of the three last abdominal segments very distinct; those of the anterior seg-

ments scarcely or not at all distinct (especially in the ♂). Anterior and lateral borders of the cephalothorax smooth. Eye eminence relatively small; smooth, or rarely provided with small, slightly distinct tubercles; widely separated from the cephalic border. Lateral pores small, oval and marginal. Anal piece large, transverse-oval or semi-circular, much wider than long, and much wider than the reflected borders of the eighth segment. Mandibles short, similar in the two sexes; first joint furnished at the base below with an acute tooth. Palpi simple; femur, patella and tibia without any process and without projecting angles; maxillary lobe provided at the base with two strong, conical teeth. Maxillary lobe of the second pair of feet very long, nearly straight from the base, not attenuated, directed mesad nearly horizontally, and united on the ventro-meson to the lobe from the opposite side without forming a sensible angle; the two together lightly arched on the cephalic border, and forming an even curve. Sternal piece large, slightly contracted between the fourth pair of coxæ, gradually enlarging and obtusely truncate cephalad. Feet very long and slender; tibia of the second pair with a few false articulations. Palpal claw denticulate.

The males of the four species so far found in South Dakota may be determined by the following key:

A distinct spur on femur of palpus ..... **calcar.**
No spur on palpus ..... 1.
1.—A distinct black dorsal stripe ..... **vittatum.**
No distinct black dorsal stripe ..... 2.
2.—Dorsum light brown; legs very long; no quadrangular reticulated patch on abdomen ..... **longipes aldrichi.**
Dorsum mostly blackish; legs moderately long; a quadrangular reticulated patch on abdomen ..... **bicolor.**

**Liobunum vittatum minor** new subspecies (Trans. Am. Ent. Soc. xix, plate 12).

*Liobunum vittatum dorsatum* Weed, Am. Nat. xxvi, p. 786.

*Male.*—Body 6 mm. long; 4 mm. wide; palpi, 6 mm. long. Legs: first, 20 mm.; second, 37 mm.; third, 21 mm.; fourth, 30 mm. Femur of first leg 5 mm.; dorsum granulate, in fully colored adults of a deep reddish brown color, with a very distinct black stripe, which begins at the eye eminence expands for a short distance, then contracts until it reaches the cephalic portion of the abdomen, whence it runs with parallel sides a short distance, then very slightly expands until it reaches the caudal third of the abdomen, where it contracts and runs as a stripe to the posterior extremity. Eye eminence of about equal height, length and breadth, sloping slightly backward, black above, lightly canaliculate, with a few (two to five or six) sub-obsolete, acute black tubercles; mandibles light brown, tips of claws black; dorsal surface of second joint sparsely covered with short

spinous hairs. Palpi long, reddish brown, depth of color varying with that of rest of body; tarsus distinctly blackish; femur with a row of short conical tubercles on its outer ventro-lateral surface, commencing near the base and running to the apical extremity, where there are about a dozen similar tubercles on the ventral surface; another short, slightly oblique series on the dorsal surface, beginning at the apical margin and extending backward about one-fourth the length of the femur; patella with a row of tubercles on its outer ventro lateral surface, similar to those on the femur, and a few obsolete ones on its dorsal and ventral surfaces; tibia with two nearly parallel rows of tubercles, one on the ventral and the other on the outer ventro lateral surface; a short row also on the distal portion of its inner ventro-lateral surface; tarsus sparsely covered with stiff hairs, and furnished with a well pronounced row of black tubercles on its inner ventro-lateral surface. Ventrum reddish brown, with more or less of a vermillion tint in some specimens, with well-marked granulations. Legs brownish black or black. Coxæ slightly tuberculate, each having a row of short tubercles on the cephalic margin. Shaft of genital organ slender, bent nearly at right angles near distal end, and terminating in a very acute point.

*Female.*—Body 8 mm. long; 5 mm. wide; palpi 5 mm. long. Legs: first, 22 mm.; second, 41 mm.; third, 23 mm.; fourth, 32 mm. Femur of first leg 6 mm. Differs from the male in having the body thicker and more rounded, and in having less reddish coloring. The palpi are much more slender, shorter, and have the tubercles partially replaced by hairs; the tip of tarsus only is blackish. The ventrum is sometimes grayish. The black central stripe is very distinct.

Described from six specimens (3 ♂, 3 ♀) taken at Brookings, South Dakota.

The male of this subspecies is accurately illustrated in Trans. Am. Ent. Soc. xix, plate 12. Its structural details are shown in fig. 2, which was drawn from a specimen of the typical *Liobunum vittatum* of the Southern States. The idea of the general structural characters of the female may be obtained from plate v, fig. 2, which also represents a typical specimen from the South.

The claims of this form to subspecific rank rest chiefly upon the extreme shortness of the legs and its melanistic tendencies, the latter being indicated by the intense blackness of the central stripe in both sexes; the unusual blackness of the legs of the female; and the blackish palpal tarsus. These characters are constant in and peculiar to the specimens from the general region under consideration.

**Liobunum longipes aldrichi,** new subspecies (Trans. Am. Ent. Soc. xix, pl. 14).

*Male.*—Body 3.8 mm. long; 3 mm. wide; palpi 3.2 mm. long. Legs: first, about 34 mm.; second, 62 mm.; third, about 35 mm.; fourth, 46 mm. Dorsum minutely tuberculate, light reddish brown, with a slightly darker subobsolete central marking, sometimes simply represented by obscure, brown blotches; margins of cephalothorax black. Eye eminence at least as broad as high, black, canaliculate, with rows of small, black tubercles on the carinæ. Mandibles

light yellowish brown, tips of claws black; second joint with sparse hairs. Palpi slender, light brown, distal portion of femur and all of patella black; femur, patella and tibia with small scattered tubercles and short hairs; tarsus pubescent, with a row of small, black tubercles on its inner ventro-lateral surface. Ventrum, including coxæ, paler than dorsum, of a nearly uniform, light brown tint; coxæ tuberculate, tips white; trochanters black. Legs long, slender, black or brownish black; generally, though not always, with apical tenth of tibiæ of second pair white. Shaft of genital organ flattened, contracted near its distal extremity and bent upward, terminating in an acute point.

*Female.*—Body 5 mm. long; 3.5 wide. Third legs, 30 mm. long. Body larger and legs shorter than in male. Dorsum mottled brown and black, with a distinct dark central marking, twice interrupted on posterior third of abdomen. Legs brown, with whitish annulations at many of the joints. Palpi colored as in ♂.

The short legs and melanistic tendencies distinguish this subspecies from the normal form in other regions. The blackness of part of the palpal joints, of the eye eminence, and of the margin of the cephalothorax, are all very pronounced.

Named for Mr. J. M. Aldrich.

**Liobunum bicolor** (Wood) Weed.

*Phalangium bicolor* Wood, Comm. Essex Inst. vi, 28.

*Liobunum bicolor* Weed, Am. Nat. xxi, 935; xxvii, 295.

*Male.*—Body 5 mm. long; 3.5 mm. wide; palpi 4 mm. long. Legs: i, 20 mm.; ii, 38 mm.; iii, 21 mm.; iv, 31 mm. Dorsum brownish black, with a faint indication of a lighter central marking, and a large, brown, quadrangular, reticulated patch on the central portion of the dorsum of abdomen, behind which are two other transverse reticulated bands. There are also on the dorsum of the abdomen more or less distinct transverse rows of whitish tubercles with black tips. Eye eminence prominent, brown, lightly canaliculate, with a row of well-developed, acute, brown tubercles on each carina. Mandibles light yellowish brown, smooth, with only a few indistinct whitish hairs. Palpi short, light brown, with femur and patella more or less dusky; all joints except tarsi, with numerous small spinose tubercles; ventral surface, including coxæ, brownish white; a transverse row of minute tubercles on each abdominal segment; coxæ closely tuberculate. Legs light brown, very slender, long; proximal joints with rows of acute conical tubercles.

*Female.*—In this sex there is a large, triangular, reticulated patch on the cephalothorax, the posterior portion including the eye eminence; between this and the quadrangular patch on abdomen is a smooth grayish black space, which is interrupted by a transverse reticulated band.

A rare species. Taken at Brookings and Custer, S. D.

**Liobunum (?) calcar** (Wood) Weed.

*Phalangium calcar* Wood, Comm. Essex Inst. vi, 26.

*Liobunum (?) calcar*, Weed, Am. Nat. xxi, 935.

*Male.*—Body 7.5 mm. long; 4.5 mm. wide. Legs: first, 31 mm.; second, 56 mm.; third, 32 mm.; fourth, 40 mm. Body pyriform. Dorsum reddish brown, minutely tuberculate; some specimens having a faint indication of a central

marking, and scattered light colored spots. Eye eminence of moderate size, of nearly equal height, length and breadth; blackish above; slightly canaliculate, with a row of small, acute tubercles on each carina. Mandibles yellowish brown, with obscure markings of a darker color, especially on the inner dorso-lateral surface of the second joint, where they are arranged in the form of a series of irregular parallelograms; dorsal surface of second joint sparsely clothed with stiff hairs; tips of claws black. Palpi long, very robust; dark reddish brown, lighter distally; femur enlarging from base to apex, with a very robust spur-like process on its outer ventro-lateral surface, near the distal extremity, the anterior edge of which is provided with a row of short black tubercles; dorsal surface of femur with numerous scattered, short, black tubercles, and a few also on the proximal portion of the inner ventro-lateral surface; sparsely provided with spinose hairs; patella short, thick, so united with the femur as to form an arch; with sparse hairs and a few scattered tubercles on its dorsal and outer lateral surfaces; tibia arched, densely clothed with long, black hairs; a patch of short, black tubercles on the proximal portion of its ventral surface, and a short row of similar tubercles on the apical portion of its inner ventro-lateral surface; tarsus terminating with a short, denticulate claw. Ventrum light reddish brown; coxæ reddish, with a few short hairs; two anterior pairs with a row of subobsolete tubercles on the cephalic border. Legs reddish brown, with darker annulations; joints near body having rows of short spines. Shaft of genital organ very robust, flattened, distally contracted and curved, and terminating in a short acute point.

No fully developed specimens of this species were present in the collections at hand, and the above measurements and description are taken from individuals from Illinois and North Carolina. I presume adult Dakota forms will have much shorter legs than the above measurements, and shall not be surprised if they prove sufficiently distinct for a subspecific name.

I have never been able to determine definitely the female of this species. Until this sex is found we shall be unable to say definitely whether the species belongs to *Liobunum* or not.

### **PHALANGIUM** Linné, 1758.

Teguments soft; dorsum furnished with small, acute tubercles, lateral pores large, elongate-oval; first joint of mandibles with no tooth on lower surface. Palpi simple, sometimes having the inner distal angle of the patella very slightly produced, but never prolonged into a process; claw not pectinate; maxillary lobe of second pair of legs much longer than wide, gradually narrowing from the base to apex, directed obliquely forward. Legs long, more or less robust. Eye eminence of medium size, canaliculate, provided with two series of pointed tubercles.

**Phalangium cinereum** Wood.

*Phalangium cinereum* Wood, Comm. Essex Inst. vol. vi, p. 25; Weed, Amer. Nat. vol. xxvi, p. 32; Trans. Am. Ent. Soc. xix, p. 269, pl. xvi.

*Male.*—Body 7 mm. long; 4.8 mm. wide; palpi 5 mm. long. Legs: first, 29 mm.; second, 51 mm.; third, 29 mm.; fourth, 38 mm. Dorsum ash-gray, sometimes more or less brownish, with a wide, vase-shaped central marking, which is sometimes obsolete. There is a transverse series of small spinose tubercles behind the eye eminence, another row on posterior border of cephalothorax, and one row on each abdominal segment except the last two; a curved series of similar tubercles is found in front of the eye eminence. These tubercles have whitish bases and acute black apices, and generally also have a spinose hair arising on one side near the apex of the white portion and reaching beyond the tip of the tubercle. In front of eye eminence there are two longitudinal series of three each of these tubercles. Lateral borders of cephalothorax subsinuate. Eye eminence low, canaliculate, with a series of five or six tubercles like those on dorsum on each carina. Mandibles brownish white, tips of claws black; second joint and apical portion of first joint furnished with short, black, stiff hairs. Palpi light brown, rather slender, first four joints with minute tubercles and short black hairs; none of the angles prolonged; tarsal joint without tubercles, but with hairs; claw moderately robust. Venter, including coxæ, light grayish brown, with many somewhat quadrangular patches of a more pronounced brown, and scattered blotches of chocolate-brown. Trochanters light brown, with many small tubercles; remaining joints of legs cinnamon-brown, more or less annulated with lighter and deeper shades; angular, with longitudinal rows of black spines; sheath of genital organ subcylindrical, truncate; shaft robust, with two lateral oval openings near distal extremity, then contracted into a blunt scoop-shaped piece, turned upward at nearly a right angle and terminating in a slender, acute point.

*Female.*—Body 8 mm. long; 5 mm. wide; palpi, 5 mm. long. Legs: first, 23 mm.; second, 42 mm.; third, 29 mm.; fourth, 31 mm. Differs from male as follows: Body larger, rounder. Dorsum darker gray, more mottled, central marking more distinct; tubercles on dorsum smaller, those on eye eminence more numerous, and those forming the longitudinal series in front of eye eminence also more numerous. Palpi with hairs, but without tubercles. Legs with annulations more distinct; trochanters without tubercles; spines on femur less prominent, and those on tibia obsolete; narrow quadrangular patches on venter of abdomen arranged in transverse series. Distal joints of ovipositor blackish; about thirty in number.

Brookings, South Dakota.

## EXPLANATION OF PLATE V.

Fig. 1.—*Mesosoma nigrum* ♂. Natural size.
" 2.—Parts of same. Magnified.
" 2*a*.—Body.
" 2*b*.—Eye eminence. Side view.
" 2*c*.—Eye eminence. Front view.
" 2*d*.—Palpus. Side view.
" 2*e*.—Claw of palpus. Side view.

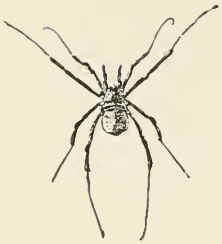


Fig. 1

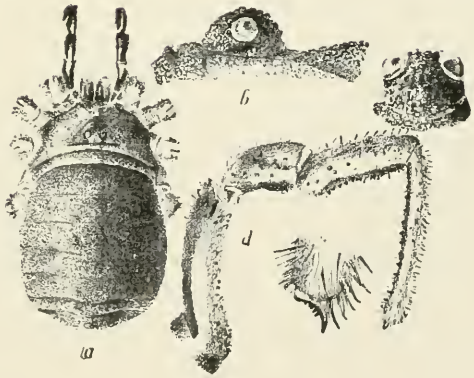



Fig. 2.

MESOSOMA NIGRUM (Say).

## THE COSMETIDÆ OF THE UNITED STATES.

BY CLARENCE M. WEED.

The family Cosmetidæ belongs to the suborder Mecostethi (Laniatores Thorell) of the order Opileonea. The first species from the United States was described* by Thomas Say as *Gonyleptes ornatum*, from specimens taken in Georgia and Florida. In 1868, Dr. H. C. Wood described† a form from Texas under Say's name, concerning the identity of which he expresses doubt. Several years later E. Simon, in his Essai d'une Classification des Opileones Mecostethi,‡ states that *G. ornatus* probably belongs to the genus *Cynorta*, and that the Texas species described by Wood is different from Say's Florida species; he proposes to call the former *C. Sayi*. Finally, in 1884, Wm. Sorensen, in his Opileones Laniatores Musei Hauniensis,§ described as *Cosmetus albolineatus*, a species from New Orleans, which he says perhaps belongs to the genus *Cynorta*.

The present study is based upon a collection of nearly two hundred specimens from Texas, Louisiana, Mississippi, Illinois and Florida. Those from Illinois belong to the Illinois State Laboratory of Natural History, while the others are in my own collection. The accompanying plate was drawn by Miss Freda Detmers.

### Family COSMETIDÆ.

Two front pairs of legs with one claw; two hind pairs with two claws; spiracles conspicuous; hind coxæ united to abdomen; palpi short, with femora compressed; tibia lamellate on both margins; tarsus short, armed with a short, strong claw.

The three species of this family as yet found in the United States all appear to belong to the genus *Cynorta* of C. Koch, which is characterized by Simon‖ substantially as follows:

Body usually longer than broad, with scutum slightly convex and not depressed in middle; scutum and ocular tubercle more or less tuberculate; palpal

* Journ. Phila. Acad. 1st ser. v. 2, p. 68.

† Comm. Essex Inst. v. vi, p. 37.

‡ Ann. de la Soc. Ent. de Belgique, 1879, p. 200.

§ Naturhist. Tidskrift, ser. iii, vol. xiv, p. 592.

‖ Ann. Soc. Ent. de Belgique, 1879, p. 190.

patella not lamellate. Legs rather short, more or less robust, first tarsus 6-jointed, with first joint not much longer than the rest, and joints 1, 2, 3, or 4 thickened, third and fourth tarsi slender.

In order to consider that in these species the first tarsus is 6-jointed, one must include the joint at the end of the metatarsus attached to the latter by an oblique false articulation (see plate vi, fig. 2, *e*). The thickening of these first tarsi is also not very distinct.

The three United States species of *Cynorta* may be separated by the following key:

Posterior pair of abdominal tubercles very prominent; four or five times as large as anterior pair..... **C. ornata.**

Posterior pair of abdominal tubercles little larger than anterior.

Dorsum with a distinct yellow Y connected posteriorly with a distinct transverse yellow line..... **C. albolineata.**

Dorsum without, or with very little yellow marking..... **C. sayi.**

**Cynorta sayi** Simon.

*Gonyleptes ornatum* Wood, Comm. Essex Inst. vi, 37.

*Cynorta sayi* Simon, Ann. de la Soc. Ent. de Belgique, 1879, p. 200.

Body 6 mm. long; 5 mm. wide. Legs: first, 8.5 mm.; second, 13.5 mm.; third, 11.5 mm.; fourth, 15 mm. General color ferruginous brown, more or less blotched with a darker shade. Legs dusky toward distal ends. In some specimens there is a more or less distinct yellow marking on dorso-meson behind eye eminence, and a transverse line near posterior margin of abdominal scutum. Eye eminence very low and wide, with a longitudinal depression between the black eyes; a pair of small, low, blunt tubercles on abdominal scutum, just back of suture between cephalothorax and abdomen; another similar pair about 2 mm. caudad of this, and behind the latter are three similar tubercles arranged transversely. The central portion of the abdominal scutum is finely and remotely tuberculate, and its margins together with the margins of the posterior abdominal segments (both on dorsum and ventrum) are much more distinctly tuberculate, the tubercles being rounded, and on the segments arranged in transverse rows; a large, distinct, slightly curved tooth is on the outer dorsal surface of the hind margin of each posterior coxa. Legs furnished with longitudinal rows of small acute tubercles. Mandibles short, first joint with a large truncate tubercle-like projection on the dorsal surface of its distal half; second joint rounded and swollen, with its claws unequal, the larger one being curved, and both having not very distinct teeth. Palpi short, robust; femur compressed, its lower surface crenulate; patella arched, swollen from base to extremity; tibia much flattened, margined at the side; tarsus short, its lower edge furnished with a few spinose hairs, armed with a strong curved claw. Genital organ of male "straight, cylindrical, distally much enlarged and abruptly truncated, its end furnished on each side with three curved, hook-like spines."*

Described from many specimens. Houston and Harwood, Texas (H. F. Wickham); Brazos County, Texas (N. Banks).

* Wood.

**Cynorta albolineata** (Sorensen) Weed. Plate vi.

*Cosmetus albolineatus* Sorensen, Natur. Tidsskrift, ser. iii, vol. xiv, p. 592.

Body 5 mm. long; 4 mm. wide. Legs: first, 8 mm.; second, 15 mm.; third, 11 mm.; fourth 15 mm. General color dark reddish brown, with apical portions of legs dusky. Dorsum striped with light yellow, as follows: a distinct V enclosing the eye eminence and having a straight line running on dorso-meson from base of V back to a rather wide, transverse, wavy line running across abdominal scutum just back of the posterior pair of tubercles. Between the two pairs of tubercles on abdominal scutum are two transverse lines, and on the side margins of the scutum there is more or less blotching with yellow. These blotches and the last-named transverse lines, and sometimes even the line on the dorso-meson, are often subobsolete, represented only by scattered yellow dots. Eye eminence very low and wide, with a longitudinal depression between the black eyes and a few small tubercles over the eyes; a pair of small, rounded tubercles on abdominal scutum, slightly behind base of V; another similar pair about 1 5 mm. caudad of this front pair, the hind ones being about twice as large as the front ones. There are a few small and scattered tubercles on the central portion of the abdominal scutum, and its margins together with the margins of the posterior abdominal segments (both on dorsum and ventrum) are much more distinctly tuberculate, the tubercles being rounded and on the segments arranged in transverse rows; a moderate tooth on outer dorsal surface of hind margin of each posterior coxa. Mandibles and palpi similar to those of *C. sayi*.

Described from many specimens; Agricultural College, Mississippi (H. E. Weed); Macomb, Miss. (F. S. Earle); Morgan City, La. (H. F. Wickham); southern Louisiana (H. E. Weed); southern Illinois (H. Garman).

**Cynorta ornata** (Say) Simon.

*Gonyleptes ornatum* Say, Jour. Phil. Acad. Nat. Sci, 1st series, vol. ii, p. 63.
*Cynorta ornata* Simon, Ann. de la Soc. Ent. de Belgique. 1879, p. 200.

Body 6 mm. long; 5 mm. wide; palpi 3.5 mm. long. Legs: first, 10 mm.; second, 18 mm.; third, 14 mm.; fourth, 19 mm. General color dark ferruginous brown; tarsi dusky, sometimes having a greenish tinge. Dorsum striped with canary-yellow as follows: a distinct V enclosing eye eminence, the base of the V being on dorso-meson half way between eye eminences and first pair of abdominal tubercles and the sides reaching nearly to margin of cephalothorax at a point as far cephalad as is the anterior border of eye eminence; from the base of the V an interrupted line runs caudad almost to the large posterior tubercles, the back half of this line is only indicated by isolated dots; just caudad of the front pair of abdominal tubercles there is a transverse line extending nearly two-thirds across the abdominal scutum, crossing the longitudinal line on dorso-meson at right angles; half way between this line and the posterior tubercles runs another similar line which is often interrupted on the dorso-meson. Starting at the cephalo-mesal corner of the base of each of the posterior tubercles a distinct line runs around the base behind, and then proceeds obliquely forward and outward until it reaches near the margin, it then curves and proceeds obliquely backwards to the margin. There is also an interrupted yellow blotch on each outer margin of the abdominal scutum opposite the anterior transverse

transverse stripe. The degree of distinctness of these markings varies much in different specimens. The eye eminence is very broad and low, with a slight longitudinal depression between the black eyes. The first pair of tubercles is about 2 mm. behind the eye eminence; these tubercles are close together, small, low, conical and truncate. The tubercles of the second pair are situated near the posterior margin of the abdominal scutum; they are nearly 1.5 mm. high, project upward and backward, and are obtusely pointed. There is a single tubercle very similar to those on the dorso-distal margin of each posterior coxa; posterior abdominal segments with rows of equidistant rounded tubercles, giving a crenulate appearance. The inner hind margin of posterior trochanters provided with a single well-developed tubercle. Inner sides of posterior legs covered with longitudinal rows of small rounded tubercles, other legs furnished with longitudinal rows of much smaller tubercles. Mandibles short, first joint with a large, truncate, tubercle-like projection on the dorsal surface of its distal half; second joint rounded and swollen, furnished with a few hairs; claws unequal, larger one curved, both provided with teeth. Palpi short, robust; femur compressed, furnished with about five compressed, rounded teeth on ventral surface; patella arched, swollen from base to extremity, its inner margin slightly roughened; tibia much flattened, margined at the sides; tarsus short, its lower edge furnished with a few spinose hairs; armed with a strong, curved claw.

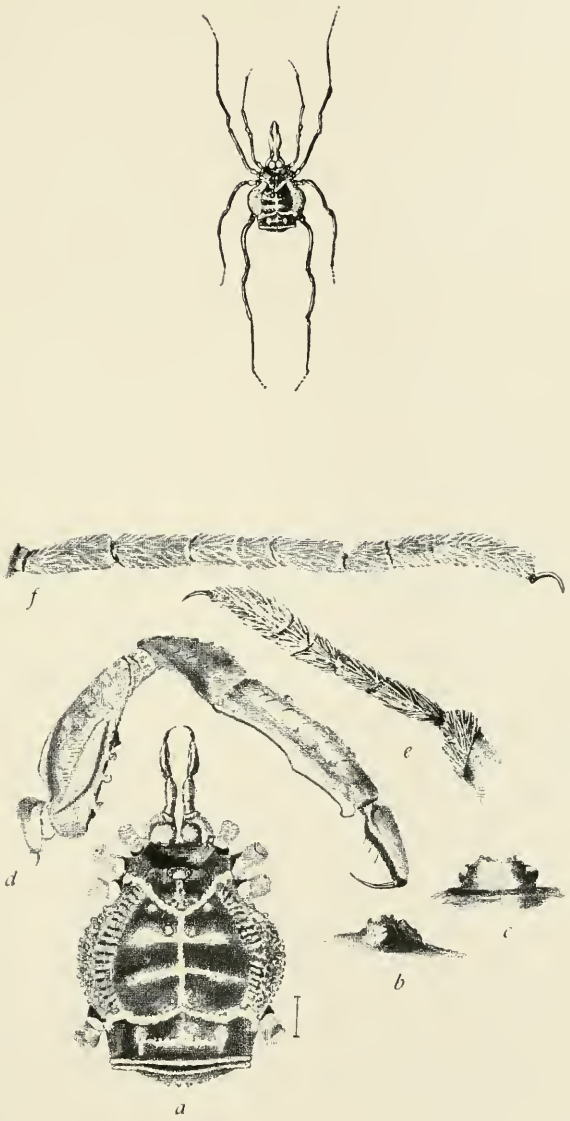
Described from many specimens; Inverness, Fla. (C. M. Weed).

In southern Florida in the Winter of 1891–92 I found this species often exceedingly abundant in the pine woods under logs. Sometimes thirty or forty would occur under a single log.

## EXPLANATION OF PLATE VI.

Fig. 1.—*Cynorta albolineata*. Natural size.

" 2.—Parts of same magnified: *a*, body; *b*, eye eminence, side view; *c*, eye eminence, front view; *d*, palpus, side view; *e*, first tarsus; *f*, second tarsus.




CYNORTA ALBOLINEATA.

## SEVENTH CONTRIBUTION TO A KNOWLEDGE OF CERTAIN LITTLE-KNOWN APHIDIDÆ.*

BY CLARENCE M. WEED.

The observations upon which the present paper is based were made during the Autumn of 1890 at Columbus, Ohio, and the Autumns of 1891 and 1892 at Hanover, N. H. The drawings illustrating this paper were made by Miss Freda Detmers, under my direction, and the photograph for Plate VII was kindly taken for me by Dr. H. H. Lamson.

**Siphocoryne salicis** Monell.

This species was abundant at Hanover on the leaves and twigs of willow during October and November, 1892. As the leaves fell the sexed forms congregated upon the twigs where the oviparous females deposited their eggs in the crevices about the buds. These eggs are nearly as long as those of *Melanoxanthus salicis*, in connection with which they often occur, but they are much more slender.

*Winged Male.*—Body 2 mm. long; 0.8 mm. wide; head to tip of folded wings, 4 mm.; antennæ, 1.1 mm.; wing expanse, 7 mm. Head blackish; prothorax yellowish or greenish, with a large dusky patch covering most of dorsum; mesa- and metathorax blackish with a little yellow about base of coxæ. Rostrum reaching second coxæ, yellowish brown, with a dusky tip. Eyes reddish; postocular tubercles not very prominent. Abdomen yellowish green, often light green, with dusky dots on margins, and large transverse dusky spots on terga of anterior segments; tip of abdomen dusky. Antennæ black, third joint longest, a little longer than iv plus v; joints iv, v and basal part of vi subequal; apical part of vi a little longer than its basal portion, and only about half as long as third joint. Wing membrane a trifle dusky because rather thickly furnished with very minute scale-like objects. Tegulæ and wing insertions brownish yellow; veins and stigma dusky, especially away from body; cornicles and cauda blackish, former long and reaching to end of abdomen. A small, acute tubercle on dorsum of penultimate abdominal segment; much less conspicuous than similar tubercle in oviparous female. Legs yellowish brown, with tips of femora and tibiæ and all of tarsi blackish; hind pair darker than the others.

Described from several living specimens on *Salix*, Nov. 10, 1892; some seen in copula with the oviparous form.

*Oviparous Female.*—Body 2 mm. long; 1 mm. wide; antennæ 0.7 mm. General color varying from apple green to ochraceous-rufous; oftenest approaching latter, and usually being colored like the buds near which the specimen is stationed,

* The previous contributions to this series have been published as follows: first, "Psyche," vol. v, pp. 123–134; second, "Psyche," vol. v, pp. 208–210; third, Bulletin Ohio Agricultural Experiment Station, Second Series, vol. i, pp. 148–152; fourth, Bulletin Ohio Agricultural Experiment Station, Technical Series, vol. i, pp. 111–120; fifth, "Insect Life," vol. iii, pp. 285–293; sixth, Bull. Ill. St. Lab. Nat. Hist. v. iii, pp. 207–214.

probably because of coloring matter in sap consumed. Dorsum of head usually nearly covered with two large, subquadrangular, dusky patches, which sometimes run together. Dorsum of prothorax with three more or less distinct small spots arranged in a triangle near margins; and one transverse spot on each side of dorso-meson near front margin; rest of dorsum with a longitudinal marginal and submarginal row of indented blackish dots on each side. In the green specimens the dorsum shows two longitudinal rows of large, transverse, quadrangular, slightly dusky patches. Antennæ short, nearly unicolorous with head or else light wood-brown, from base to apical fourth of third joint; from there to tip dusky, first and second joint normal; third longest, about equal to iv plus v, which are subequal; basal part of joint vi a little longer than v, and same length as its apical portion. The median portion of the tergum of the penultimate abdominal segment produced into a prominent, subconical, truncate tubercle, projecting caudad; this is generally dusky at tip. Eyes dark, postocular tubercle not very prominent; cornicles dusky, especially at tip; more than half as long as antennæ; slightly expanding toward tip, then suddenly contracting and ending with a flange; cauda well developed, dusky at tip; rostrum short, barely reaching second coxæ, dusky at tip. Legs light wood-brown, with tips of tibiæ and all of tarsi of first two pairs, and all of tibiæ and tarsi of hind pair dusky.

Described from many specimens on *Salix*, at Hanover, N. H., Nov. 10, 1892. One had three eggs in abdomen.

*Egg.*—Length 0.8 mm. Suboval, one side (that by which attached) usually being nearly straight, and the other much curved; yellowish when first extruded, but soon changing to shining black. Deposited in crevices between buds and twigs.

Described from many specimens on *Salix*, Nov. 10, 1892.

**Aphis euonymi.**

In the Autumn of 1890 the oviparous forms of *Aphis euonymi* were common on the leaves and twigs of the burning bush (*Euonymus atropurpureus*) in the vicinity of Columbus, Ohio.

*Oviparous Female.*—Length 1.5 mm.; width across abdomen 0.6 mm.; antennæ, 0.7 mm. Body obovate, tapering to a point; a row of indentations near outer

Fig. 1.—**Aphis euonymi**: *a*, oviparous female, magnified; *b*, head and antenna of same, greatly magnified; *c*, eggs on twig, magnified.

end of margin. Color deep, dark brown, bronzy in some lights; antennæ dusky, except proximal half of third joint, which is whitish; first two pairs of legs with coxæ unicolorous with body, femora and tibiæ whitish or yellowish, with

dusky tips, and tarsi dusky; posterior pair dusky throughout. Prothorax with lateral tubercles. Antennæ 5-jointed; joint iii long, longer than iv plus the basal part of v; terminal part of v quite long, with several very small pores; v imbricated; cornicles short, cylindrical concolorous with body; cauda well developed, pilose.

*Egg* 0 5 mm. long. Oval, shining black, though green when first laid. Deposited on the twigs about the buds.

**Aphis cornifoliæ.**

On Nov. 1, 1892, I found numbers of this species on the leaves and branches of the common Red Osier Dogwood (*Cornus stolonifera*). The forms present were the winged viviparous females (return migrants), winged males, oviparous females and eggs. Each of these forms corresponded precisely with the descriptions of similar forms taken in Illinois in 1887 recorded in the first of this series of contributions.* The conditions were also the same as regards the establishing the colonies of the oviparous females by the winged return migrants and the flying in of the males. No indications were seen of the development of either of these winged forms on *Cornus*, and I have no doubt that the species passes the Summer on some other plant.

**Aphis mali** Linn.

Observations on the Autumn history of this species in New Hampshire showed a condition of things exactly similar to what I have found in Michigan, Illinois and Ohio during the last ten years. Early in September the previously unoccupied apple leaves begin to be colonized by winged return migrants that give birth to the oviparous females. Later the males fly in. The eggs are deposited on the twigs and buds.

*Oviparous Female.*—Body 1.4 mm. long; 0.7 mm. wide; antennæ 0.6 mm. long. Commonest color of fully matured specimens chromium green (Ridg. x, 12), but some specimens light apple green (Ridg. x, 20, but lighter) and more rarely a brown form occurs. In the green specimens the antennæ and legs are dusky, especially toward their tips; and there is a more or less distinct yellowish brown patch at the base of the cornicles. Cornicles rather short, slightly flanged at tip; darker than body. Third joint of antennæ a little more than twice as long as fourth; basal part of fifth distinctly shorter than fourth; apical part of fifth distinctly longer than third. Rostrum reaching as far as anterior margin of posterior coxæ; dusky at tip. Style short, dusky.

Described from many living specimens ovipositing on twigs of *Pyrus malus* at Hanover, N. H., Nov. 7, 1892.

*Winged Viviparous Female. Return Migrant.*—Body 2 mm. long; head to tip of folded wings, 4.2 mm.; antennæ, 1.2 mm.; wing expanse, 1 mm. Head and thorax black, with connecting membrane greenish; abdomen apple-green or oil-green, usually latter, with marginal rows of black spots on dorsum. In older specimens that have nearly finished bearing young, the abdomen may become

* Psyche, vol. v, pp. 123-125.

almost black. Legs black, except bases of femora, which are brown; tegulæ oil-green; wing insertions yellowish; veins and stigma yellowish brown, lighter near body; stigma darker than the veins, sometimes dusky. Antennæ on slight frontal tubercles, black; joint iii equal to iv plus v; iv a little longer than v; basal part of vi short, a little more than half as long as v; distal part of vi distinctly longer than iii, with three minute spines at tip, the inner longest and recurved. Cornicles dusky, of medium length, very slightly swollen from base outward, flanged at tip. Style well developed, sides parallel till toward tip, where they contract to meet in a right angle.

Described from many living specimens on *Pyrus malus*, Nov. 4, 1892, Hanover, N. H.

**Melanoxanthus salicti** (Harr.).

This species is very abundant in Hanover, often almost covering large trees. Its habits and appearance here are precisely like the species as I found it in Ohio, and described in previous contributions of this series. Large numbers of the wingless forms were affected by a small Hymenopterous parasite.

**Melanoxanthus salicis** (L.).

This species occurred commonly about Hanover during the Autumn of 1892. The form, color and habits were precisely like those observed in Ohio, except that wingless males—a form not before found, were rather common.

*Wingless Male.*—Body 2.4 mm. long; 1 mm. wide; antennæ 1.5 mm. long. Body flattened, elongate, and with legs and antennæ very hairy. Dorsum bluish black, with more or less glaucous bloom, and a faint indication of a whitish, central, longitudinal marking, and a row of indistinct white dots along dorsal margin at each side of abdomen. In some specimens dorsum of head and thorax, slightly tinged with brown. Basal half of antennæ brown, the rest black; eyes black; cornicles orange-yellow, paler at base and tip; ventrum drab-brown, darker toward cauda. Legs russet-brown, with coxæ unicolorous with ventrum, with tips of femora (especially in last pair) and tibia together with all of tarsi, blackish; rostrum drab-brown at base, dusky toward tip. Third joint of antennæ longest, but much shorter than joint iv plus v, the latter being subequal; vi and vii also subequal, the two together being about as long as v. Third joint with many pores; a well-developed tubercle on each side of the prothorax.

Described from many living specimens, one of which was seen *in copula* with an oviparous female, taken on *Salix* at Hanover, N. H., October, 1892.

**Melanoxanthus flocculosus** Weed.

A few colonies of this species were found upon willow in Hanover. The wingless male was common in October. It may be described as follows:

*Wingless Male.*—Body 2.8 mm. long; 1 mm. wide; antennæ 2 mm. long. Body long, slender, flattened; its sides parallel from mesothorax to base of cornicles; flocculent, especially on ventrum and dorsal margins of abdomen; a distinct margin on each side reaching from mesothorax to end of abdomen. General

color dull yellowish brown, with a longitudinal row of large, quadrangular, black spots on each side of dorso-meson, and a row of less distinct black spots along each margin; on head and prothorax these spots so run together that they are usually not distinguishable from each other; eyes black; cornicles orange, or orange-yellow, usually paler at the base, slightly expanding from base to near tip, and then contracting to an obtuse point; not flanged at tip. Antennæ long, slender, black; joint three longest, but shorter than four plus five, the latter being subequal; the proximal and distal parts of six subequal, the whole joint being as long as five. Cauda short, obtusely rounded at tip. Legs long, black, with base of femora yellowish brown. A very small pointed tubercle on each side margin of prothorax; sometimes obsolete. Antennæ and legs sparsely furnished with short hairs.

Described from several living and dead specimens taken on *Salix* Oct. 28, 1892. Some of the specimens were *in copula* with oviparous females.

**Lachnus strobi** Fitch.

A number of young white pines infested by this species were found at Hanover during the Autumn of 1892. The forms present were the winged males, the wingless oviparous females and the eggs. The habits and conditions were precisely the same as observed in Ohio, and reported in the fifth of this series of contributions.

**Pemphigus imbricator** (Fitch).

This species, originally described by Dr. Fitch as *Schizoneura imbricator*, was rather common on beech trees in the vicinity of Columbus during the Autumn of 1890. Infested twigs look, at little distance, as if covered on the underside with wool or cotton, on account of the long cottony secretion with which the insects are furnished. The wingless forms and nymphs are especially provided with this substance. When a colony is disturbed each aphid emits a small drop of "honey-dew" and the nymphs begin waving their abdomens back and forth. Late in October and early in November the only forms present, so far as my observations went, were winged viviparous females, and nymphs of the same. I was unable to determine the method of hibernation.

*Winged Viviparous Female.*—Body 4 mm. long by 1.5 mm. wide across abdomen. Head to tip of folded wings 7 mm. Wing expanse 13 mm. antennæ 1.1 mm. Head and thorax black, with more or less brown between articulations, especially on ventral surface. Abdomen yellowish, or greenish brown, with an olive-green vase-shaped marking on middle of dorsum, and a longitudinal marking of same color near each margin, the latter often uniting posteriorly by a faint curved transverse line as shown in the figure. Legs piceous, except bases of femora, which are sometimes brown. Antennæ piceous; joint iii equal to iv plus v.

which are subequal; vi, longer than v, with the thumb-like tip very short. Rostrum reaching second coxæ. Wings hyaline; radius and stigma piceous, other veins brown.

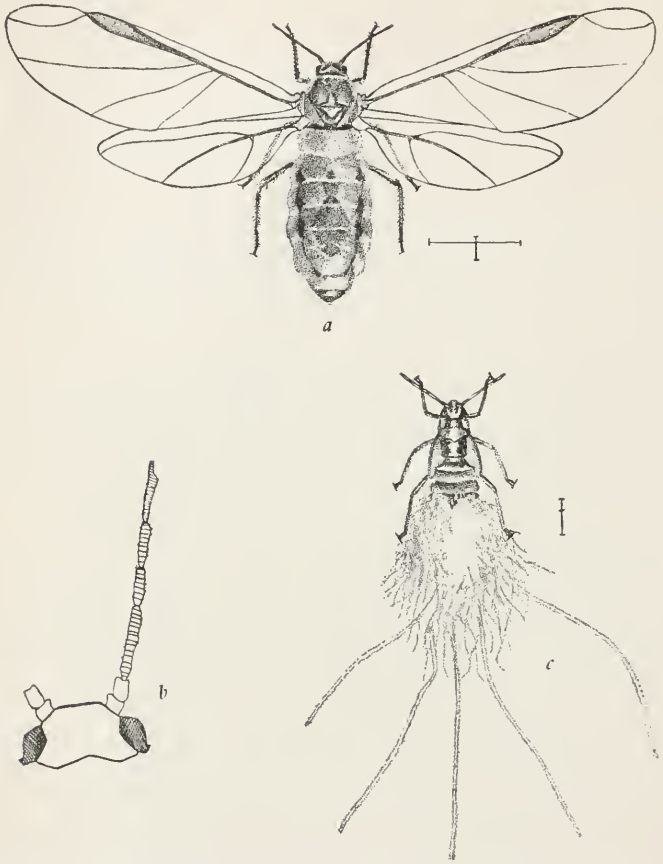



Fig. 2.—**Pemphigus imbricator:** *a*, winged viviparous female; *b*, head and antenna of same; *c*, nymph of same. All magnified.

Described from many living specimens on limbs of *Fagus ferruginea*, Autumn, 1890.

**Phyllaphis** sp. (on beech).

During the Autumn of 1890 I found a species of *Phyllaphis* on beech in central Ohio, the oviparous form of which agrees with Buckton's short description and figure of *P. fagi*. I presume that it is that species, but do not think the present evidence justifies a definite reference to that effect. The colonies were found on the underside of the leaves, with more or less flocculent matter about them. The sexed forms developed during October, and the oviparous females wandered over the bark of the twigs, limbs, and trunk in search of crevices in which to deposit their eggs. When a suitable

place is found the egg is laid, and then driven into position by the following method: The insect so places itself that its hind legs easily touch the egg, then standing on its four front ones it brings the two hind ones down upon the egg in rapid succession, striking with considerable force. This serves the double purpose of pushing the egg in place, and of drawing out a viscid secretion, with which it is covered, into a thread-like, silvery film, that so resembles the surrounding bark that it is difficult to detect it. I watched an oviparous louse go through this process for about a minute and a half.

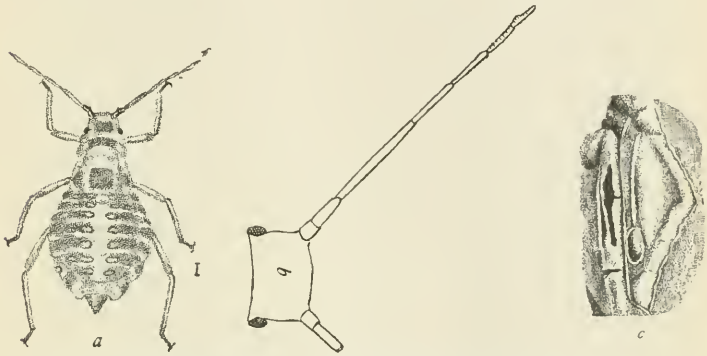



Fig. 3.—**Phyllaphis** of beech: *a*, oviparous female, magnified; *b*, head and antenna of same, greatly magnified; *c*, egg on bark, magnified.

*Oviparous Female.*—Body 2.4 mm. long by 1 mm. wide across abdomen. Antennæ 1.2 mm long. Body elongate, somewhat pyriform and flocculent. General color pale green; a large quadrangular spot on the dorsum of head and prothorax, three spots on mesothorax, and six spots on the dorsum of each of the seven anterior abdominal segments, and three spots on eighth abdominal segment, olive-green. Legs with a slight dusky tinge. Antennæ more markedly dusky, except proximal portion. Eyes reddish; antennæ 6-jointed; joint iii longest; iv, v and vi subequal. Rostrum very short, scarcely reaching second coxæ. Body sparsely provided with spatulate or capitate hairs. Cauda short, globular.

*Egg.*—Small, only 0.6 mm. long. Greenish when first laid, but becoming dark gray, very much the color of the beech bark; covered with a filmy substance that helps to conceal it.

Deposited in crevices of bark.

**Schizoneura tessellata** Fitch.

This species, commonly known as the woolly alder *aphis*, has been extremely abundant in New England during recent years. Its Winter history seems never to have been precisely determined. My observations upon it began in October, 1891, at Hanover. At that time great numbers of young were being born from the colonies of oviparous females present on the twigs. During the latter part of the month and throughout the early part of November these young did not remain on the twigs, but wandered down the trunk to the soil surface. Here they congregated in enormous colonies in the

crevices between the base of the trunk and larger roots and the soil, or beneath the fallen leaves or other rubbish at the soil surface. Here they remained until Spring, when they took advantage of the first warm days to crawl up the trunk to the twigs. So early as April 9th I found that large numbers had already established colonies on the twigs, the pulverulence developing so that many of them had a distinct coating of white. The afternoon of the 9th was cold, and a very few of the young lice were seen ascending the alder stems. There were a great many yet remaining in the rubbish. I made another observation a week later (April 16th), the afternoon being warm and sunny. Many of the young aphids were then ascending the alder stems; nearly all were headed away from the roots, but occasionally one was going sideways, and rarely one was turned toward the roots. Many were yet below, especially where the base of the stems were thickly covered with fallen leaves. The colonies were numerous on the young twigs, but there were none on the old ones.

Enormous numbers of these young lice must be washed away by the falling rains and melting snow. I found many of them among the stones along a brook, often on the undersides of the stones in the nests of ants (*Lasius*) with *Dactylopius* and the eggs of aphides, but the ants paid no attention to the young *Schizoneuras*.

The dead Autumn colonies are almost as conspicuous in Spring as they were the previous Autumn.

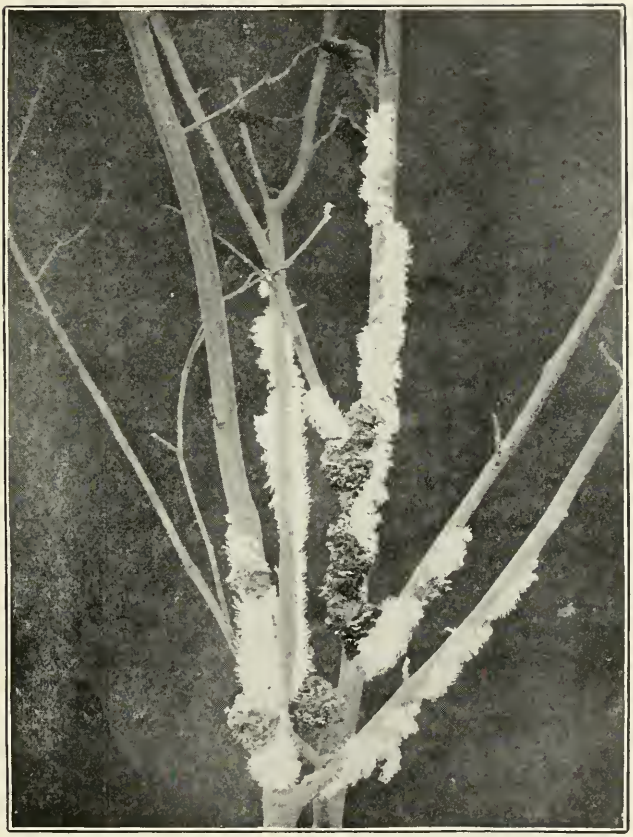
The young as it comes out of Winter quarters in early Spring may be described as follows:

*Young in Spring.*—Body 1.2 mm. long; 0.7 mm. wide. General color olive-green, with tips of antennæ, tip of rostrum and claws, blackish. Body, including legs and antennæ, thickly furnished with rather long, stiff hairs, having recurved tips. Six longitudinal rows of pulverulent spots on abdomen, running together on last two segments. Similar spots on head and thorax, but in less distinct rows. The size and amount of pulverulence varies considerably, those on the borders of having less, thus indicating more recent arrival from below.

The adult viviparous female which in Autumn gives birth to the hibernating form is described as follows:

*Apterous Viviparous Females.*—Body 5 mm. long, 3 mm. wide. Body pear-shaped; abdomen large and swollen; color lead-gray throughout; antennæ light grayish brown, sometimes with a greenish tinge, and terminal joint dusky. Legs brown, with tips of joints black. Antennæ very short; joints iii, iv and v swollen on posterior side; third joint nearly twice as long as second; fourth very short, less than half as long as third; fifth short, a very little longer than third. Segmentation of abdomen very distinct. Rostrum short, robust. Dorsum furnished with a long pulverulent coating.

I put a number of specimens of this form in empty vials October 17th, and during the next five days one of them gave birth to forty young. The appearance of a branch infested by these insects and the fungus which accompanies them is shown on Plate VII.



SCHIZONEURA TESSELLATA Fitch.

# THE ENTOMOLOGY OF THE MID-ALPINE ZONE OF CUSTER COUNTY, COLORADO.

BY T. D. A. COCKERELL.

The present paper is based upon collections made during a residence of about three years (1887–1890) in the district to which it relates. Although the number of insects already recorded from Colorado is very great, the information available, from which a student of geographical distribution can arrive at satisfactory conclusions, is comparatively scanty. The reason of this unfortunate state of affairs is, that the great majority of recorded species are cited merely as from Colorado, without the locality or altitude being given; and as within the limits of the State there are two or three distinct faunæ, the result on compiling the statistics is something like a jumble of the faunæ of Alaska, Minnesota and Texas. Owing to this meeting of different faunæ in Colorado, the State as a whole is extraordinarily rich in species.

The insect fauna of the mid-alpine zone of Custer County presents some elements which are sufficiently diverse; but taken as a whole, it is a natural fauna, belonging to a well-defined region, and hence available for comparison with other like faunæ. It is, indeed, truly characteristic of the mid-alpine, that besides its ordinary elements, it contains species coming up from the sub-alpine, and down from the high alpine; but although it thus happens that *Junonia cœnia* and *Parnassius smintheus* have been taken in the same zone, it does not follow that either are truly characteristic of it, or that they belong to the same fauna. All faunal lists contain such exceptions or deviations from the average; but when, as in the case of Colorado as a whole, there is no uniformity about the range of the various species, and the majority do not occur throughout the territory, it is impossible to treat the region as containing a single fauna.

The insects herein enumerated are only a portion of those taken, but they are enough to draw conclusions from. Almost the whole of my collections have been distributed, and very many of the more obscure species are at the British Museum unidentified. The Coleoptera are mainly in Dr. J. Hamilton's collection, and I have been

indebted to him for the identification of most of the species. Some few were sent to Dr. Horn, and others are in the U. S. National Museum. The Rhopalocera were mostly identified by Mr. W. H. Edwards; a good many species were sent to Mr. Elwes, but he did not send me their names. Mr. Nash, of Pueblo, very kindly gave me information about his captures at Rosita and elsewhere, from which I have quoted largely. The Heterocera I found it difficult to get named, and so the list is small. Mr. Hulst was very kind in identifying species, and the late Mr. Hy. Edwards sent me the names of a few. A good many were sent to Mr. Strecker, but I only got the names of two or three. Mr. Beutenmüller has some of the small species, and so has Prof. Fernald. Some were also sent to Lord Walsingham. The Hymenoptera, with some few exceptions, were sent to Mr. Ashmead, who was most kind in identifying them. Mr. Ashmead also has most of the Hemiptera. Prof. L. Bruner has the Orthoptera, which he kindly identified. I could not find any one to name the Neuroptera, although I sent some species to Mr. McLachlan. The Diptera are mostly unnamed, except a few which I worked out myself. The Arachnida went partly to the Rev. O. P. Cambridge, and partly to Dr. Thorell, but I did not learn the names of the species, although Mr. Cambridge kindly identified the genera. Finally, thanks are due to Prof. Riley and his colleagues at the U. S. Department of Agriculture for constant assistance and advice, which has been invaluable to me.

## THE MID-ALPINE ZONE OF CUSTER COUNTY.

The mid-alpine zone, as I have defined it,* extends from about 6500 feet to 10,000 feet. It is essentially the zone of oak-scrub (*Quercus undulata*) and quaking asp (*Populus tremuloides*). Its most characteristic conifer is *Pinus ponderosa* var. *scopulorum*, but with the high-alpine zone it shares *Picea engelmanni*, with the sub-alpine, *Pinus edulis* and *Juniperus virginianus*. The mid-alpine of Custer County is practically the same district as Wet Mountain Valley. This valley has an altitude of about 8000 feet; it is bordered on the east by the Wet Mountains, and on the west by the Sangre de Cristo Range. The central portion of the valley is open prairie land, but the mountain slopes are wooded. Rosita, on the slope of the Wet Mountains, is 8736 feet above sea-level. The two towns situated on the open plain are Silver Cliff, 7990 feet, and West Cliff,

* See "Entomological News," 1892, p. 203.

7864 feet (sometimes given as 7718 feet). Not far off is Ula, 7819 feet, now hardly a village.

The valley is watered mainly by Grape Creek, which rises to the south, near Music Pass, and passing West Cliff, Ula and Dora, goes down a narrow cañon to join the Arkansas close to Cañon City. Short Creek, coming from the vicinity of Gibb's Peak, and Swift Creek, descending from the Lakes of the Clouds, both belong to the Grape Creek basin ; but immediately to the north of these is Willow Creek, which belongs to the Texas Creek basin. Texas Creek, of which Brush Creek is a tributary, does not run into Grape Creek, but flowing northward joins the Arkansas higher up. The Cusack Ranch, 8192 feet, is situated just on the divide between the Grape Creek and Texas Creek basins, and also at the junction of the forest and the open country, so that it is an exceptionally good locality for collecting. The latitude of Wet Mountain Valley is about 38° N.

## CLIMATE.

The climate is dry ; not too hot in the Summer, cold in the Winter. The earliest flowers—*Anemone patens* var. *nuttalliana*—appear at the end of March or beginning of April. Humming-birds arrive at the end of May, and the night-hawks at the beginning of June (for further details, see the 9th and 12th Reports of the Colorado Biological Association).

## PLANTS CHARACTERISTIC OF THE REGION.

The following plants may be noted as characteristic of the mid-alpine zone of Custer County, Colorado: *Clematis douglasii*, Hook.; *Anemone cylindrica*, Gray ; *A. patens* var. *nuttalliana*, Gray ; *Ranunculus cymbalaria*, Pursh ; *Caltha leptosepala*, DC. ; *Delphinium scopulorum*, Gray ; *Aconitum columbianum*, Nutt. ; *Berberis repens*, Lindl. ; *Argemone platyceras*, L. and O. ; *Viola nuttallii*, Pursh ; *V. canadensis*, L. ; *Silene scouleri*, Hook ; *Sidalcea malvæflora*, Gray ; *S. candida*, Gray ; *Malvastrum coccineum*, Gray ; *Linum perenne*, L. ; *Thermopsis montana*, Nutt. ; *Oxytropis lamberti*, Pursh ; *Rubus strigosus*, Mx. ; *Potentilla fruticosa*, L. ; *Rosa blanda* var. *arkansana* (Porter) ; *Ribes aureum*, Pursh ; *Epilobium angustifolium*, L. ; *Œnothera biennis*, L. ; *Cereus viridiflorus*, Eng. ; *Ligusticum montanum*, B. and H. ; *Cymopterus montanus*, T. and G. ; *Heracleum lanatum*, Mx. ; *Townsendia sericea*, Hook ; *Aster lævis*, L. ; *Antennaria dioica*, Goertn. ; *Achillea millefolium*, L. ; *Senecio aureus*, L. ; *Cnicus ochrocentrus*, Gray ; *Campanula rotundifolia*, L. ; *C. planiflora*, Eng. ;

*Arctostaphylos uva-ursi* (L.); *Gentiana humilis*, Stev.; *G. serrata*, Gunner; *Gilia aggregata*, Spreng.; *Pentstemon acuminatus*, Dougl.; *Mimulus luteus* L.; *Castilleia integra*, Gray; *Euphorbia montana*, Eng.; *Quercus undulata*, Torr.; *Populus tremuloides*, Mx.; *Iris missouriensis*, Nutt.; *Bouteloua oligostachya*, Torr.; *Pinus ponderosa* var. *scopulorum*, Eng.; *Picea engelmanni* (Parry); *P. pungens*, Eng.; *Marchantia polymorpha*, L.; *Bovista circumscissa*, B. and C.; *Hypocrea richardsoni*, B. and M.; *Uredo ribricola*, C. and E.; *Claviceps purpurea*, Tul., and *Valsa nivea*, Fr.

### CHARACTERISTIC BIRDS.

Under this head the following may be mentioned as examples: *Merula nigratoria*, L.; *Sialia arctica*, Swains.; *Chelidon erythrogastra*, Bodd.; *Pica rustica*, var. *hudsonica*, Scop.; *Agelœus phœniceus*, L.; *Scolecophagus cyanocephalus*, Wagl.; *Sturnella neglecta*, Aud.; *Cyanocitta stelleri* var. *macrolopha*, Baird; *Timunculus sparverius*, L.; and *Ægialitis vociferus*, L.

### CHARACTERISTIC MOLLUSCA.

The only slug is *Agriolimax campestris* var. *montanus*, Ing. Of the land shells one may mention *Hyalinia arborea*, Say; *Patula strigosa* var. *cooperi*, W. G. Binn.; *P. striatella*, Anth.; *Vallonia pulchella* var. *cyclophorella*, Ancey; *Pupa coloradensis*, Ckll.; and *Succinea avara*, Say. Of fresh water shells, *Limnæa truncatula*, Müll.; *Physa heterostropha*, Say; *P. hypnorum*, L.; and *Pisidium abditum*, Hald.

### CHARACTERS OF THE INSECT FAUNA.

The species found in our district are numbered consecutively in the list. To some are appended dates of capture and precise localities; of others I have nothing particular to record, and so the name alone appears. I have also added to many of the species information as to the distribution elsewhere, North or South, up or down, etc., so that the reader can see at a glance the relations of the component parts of the fauna. It may be suggested that the same information could have been conveyed by compiled statistics, but I believe that the method adopted, of giving details regarding each species separately, is much clearer and more useful, although taking up more space. The difficulty with statistics is, that they have to be taken on trust, if the facts on which they are based do not appear in the same paper; this is just what I want to avoid in the present

contribution, I want rather to so present the facts that the reader may compare them and judge for himself, correcting the details or adding to them when necessary.

Among the Coleoptera it will be noticed at once how many of the species are boreal, extending to Canada (*sens. lat.*) and often to the New England States. The Southern element is but slight, although distinct if looked for; and there is also a fair number of species endemic in the Rocky Mountains. The Tenebrionidæ, characteristic of the Western prairies, are fairly numerous. The Coleopterous fauna, as a whole, is strikingly distinct from that of the Mississippi region and the Eastern States generally, except as regards the boreal element. Mr. Wickham has published a list of the beetles found in the vicinity of Iowa City, and on comparing it with the present list, I was astonished to find how few were the species common to both. This result is brought about in large measure, no doubt, by the different character of the forests—those of Iowa containing a great variety of deciduous trees, those of Colorado mainly conifers, with very few deciduous species. Thus, it happens that not one species of Cerambycidæ is common to the Custer County and Iowa City lists, although six species are common to our district and the much more distant State of New Jersey.

The Rhopalocera are boreal with a strong Western element, and a rather surprising number of Southern forms—some of which, however, are evidently represented only by stragglers. Thus, *Callidryas eubule* at Rosita seems quite out of place, but the occurrence is less remarkable when we remember the strong migratory tendencies of the genus. *C. philea* has been taken in Arapahoe County, Colorado, by Mr. H. G. Smith, Jr., as I learned from Mr. Nash. *Terias nicippe*, however, is not accidental, and *Nathalis iole* is very well established and common. The Heterocera show similar tendencies. The really neotropical *Erebus odora* is an occasional visitor.

The Hymenoptera, especially among the parasitic groups, show many apparently endemic forms—but it is probable that further knowledge will prove that most of them are more widely distributed. Thus, *Monodontomerus montivagus*, known only hitherto from Wet Mountain Valley, has recently turned up in California. With the aid of Mr. Cresson's invaluable list, I made out the affinities of the 88 *aculeata* of Wet Mountain Valley to be as follows:

| | |
|---|---|
| Boreal | 31 |
| North America generally | 4 |
| Rocky Mountains only | 39 |
| Texas region and South | 11 |
| Eastern States | 2 |
| California | 1 |
| | 88 |

Of the Heteroptera, 28 are boreal or widely distributed, 13 Western, and two Southern. *Conorhinus* (species not identified) is a Southern type. For the rest, see the information given in the list. The fauna, as a whole, is decidedly boreal.

### COMPARISON WITH THE HIGH-ALPINE ZONE.

The high-alpine zone in Custer County extends from 10,000 feet on the Sangre de Cristo range to the summits of the mountains (Gibb's Peak, wrongly called Gibson Peak, 13,729 feet; Horn's Peak, 13,447 feet; Humboldt Peak, 14,041 feet, etc.). A list of the high-alpine species, so far as observed, is given in "Can. Ent." 1890. Although the number of records is not great, they show that the high-alpine and mid-alpine zones are sufficiently distinct.

Of high-alpine Hymenoptera, 49 species were identified, and the result of comparing these with the mid-alpine is as follows: Out of 14 high-alpine families, two (Sapygidæ and Oryssidæ) were not found in the mid-alpine zone. One subfamily, Perilampinæ, is not mid-alpine. Of 42 genera, 16 (rather less than one-third) are not mid-alpine. These are *Oryssus*, *Macrophya*, *Diaeretus*, *Sapyga*, *Perilampus*, *Aspilota*, *Aphidius*, *Sphecodes*, *Dolichopselephus*, *Pteromalus*, *Atractodes*, *Leptacis*, *Psilophrys*, *Calliopsis*, *Tenthredo* and *Microbracon*. Out of 49 species, 25 are not mid-alpine—about one-half.

Of the high-alpine Coleoptera, 25 species are recorded, and a 26th may be added, namely, *Coccinella trifasciata* L., from near the Micawber Mine in October. It extends to Canada, Lapland, etc. Of these 26, seven genera are not mid-alpine, namely, *Orsodachna*, *Dichelonycha*, *Chrysobothris*, *Zeugophora*, *Athous*, *Dasytes* and *Glyptina*. Eleven of the species are wanting in the mid-alpine collections.

Of the Lepidoptera ("Can. Ent." 1890, pp. 57, 76) nine species are not mid-alpine. To these may be added an insect doubtfully referred to *Choreutus silphiella* Grt., from the Micawber Mine: this represents a family not mid-alpine. Lord Walsingham has the specimen.

These statistics would undoubtedly be altered by further research, but I do not think they can be without significance. That the high-alpine and mid-alpine fauna are largely of different derivation seems to be proved by the large proportion of *generic* difference. Thus, 25 distinct species of Hymenoptera include no less than 16 genera; and eleven Coleoptera include eight genera. The high-alpine, therefore, is not, as regards its peculiar features, derived from the mid-

alpine or lower; contrasting in this respect with the high-alpine of Ecuador, which is so derived.

### THE HIGH-ALPINE COMPARED WITH NORTHERN REGIONS.

The affinities of the high-alpine not being with the mid-alpine, they could only be with the far North. Alberta being a suitable region for comparison, I wrote to Mr. Thomas E. Bean, asking him to tell me how many of my high-alpine species occurred with him. He most kindly replied, giving me the following interesting information:

Of the Coleoptera, he finds at Laggan *Dolopius lateralis, Podabrus lateralis, Orsodachna atra, Cicindela longilabris, Adoxus vitis, Chrysobothris trinervia, Coccinella transversoguttata, Trichodes ornatus, Acmæops pratensis* and *Mordella scutellaris.* He adds: "That is a good sprinkling, considering that I derive the facts from a small lot I sent Mr. Fletcher several years ago, presumably the commoner species."

Of the Rhopalocera, he has taken the following:

*Lycæna sæpiolus*, Laggan, 5000 ft.
*Pyrameis cardui*, Laggan, 5000 ft.
*Anthocharis ausonides*, Laggan, 5000 ft. Rare.
*Vanessa milbertii*, Laggan, 5000 ft. Also 7000 to 8000 ft.
*Pieris oleracea*, Laggan, 5000 ft. to 6500 ft.
*Papilio rutulus*, on the Columbia near Golden, B. C., altitude about 2550 ft.
*Chionobas chryxus*, Laggan, 5000 to 7000 ft
*Colias eurytheme*, Laggan, 5000 ft. "Occurrence intermittent, as our altitude is almost above its limit."
*Vanessa antiopa*, Laggan. "Chiefly 5000 ft., but sometimes find larvæ up to about 5500 ft."
*Parnassius smintheus*, Laggan, 5000 ft., and again 7000 to 8000 ft.
*Pieris protodice*, once only at Laggan, 5000 ft.
*Pieris occidentalis*, Laggan, 5000 to 8000 ft.
*Satyrus charon*, Laggan, 5000 ft.

It is to be observed that Mr. Bean does not take our characteristic high-alpine species of *Colias*—*C. scudderii* and *C. meadii.*

The timber line at Laggan is at 7000 ft.

### MID-ALPINE COMPARED WITH SUB-ALPINE.

For information about the sub-alpine zone of Custer County, and the adjacent parts of Pueblo County, see "Entomologist," December, 1888, pp. 298-305; and 1889, pp. 113 and 190; 1890, p. 19. In making comparisons with the mid-alpine of Custer County, only this district will be considered, as the sub-alpine of localities not imme-

diately adjacent might show other differences than those due to altitude.

Thirty-six Coleoptera were found and identified in the sub-alpine zone, and of these twenty-two, or nearly two-thirds, were not found in the mid-alpine. These include the following eleven genera not found in the mid-alpine: *Pityophagus*, *Batyle*, *Ditylus*, *Badister*, *Serica*, *Diabrotica*, *Tomicus*, *Polyphylla*, *Euryomia*, *Listrus* and *Desmaris*. Of the thirty-six species, one only, *Hippodamia convergens*, was observed to range up to the high-alpine.

Of fourteen Orthoptera from the sub-alpine of Custer County, not a single species was found also in the mid-alpine. Of twelve sub-alpine genera the following eight are not mid-alpine: *Mermiria*, *Hadrotettix*, *Œdipoda*, *Scyllina*, *Acridium*, *Dissoteira*, *Mestobregma* and *Philibostroma*.

Thus, in both Coleoptera and Orthoptera, the difference between the two zones is seen to be very marked, not only as to species, but also as to genera, showing that we have to deal with distinct faunæ.

With the Rhopalocera, so far as my observations went, the differences were by no means so marked. Many species of butterflies undoubtedly fly over a considerable range of altitude, and I was convinced in Wet Mountain Valley that a number of individuals of *Danais plexippus*, *Colias eurytheme*, etc., were to be caught at altitudes a good deal above where they had been bred. But however this may be, several species certainly range right up from the sub-alpine to the high-alpine,—such are *Phyciodes camillus*, *Nathalis iole*, *Limenitis weidemeyerii* and *Colias eurytheme*.

Of course there are also many sub-alpine species which do not range upwards in this manner. Mr. Nash kindly gave me much information about his captures, extending over several years, and the following, among others, were all taken by him in Pueblo County: *Colias cæsonia* Stoll., *Phyciodes picta* Edw., *Grapta interrogationis* Fab., *Satyrus alope* Fab., *Limenitis disippus* Godt., *Paphia troglodyta* Fab., *Thecla melinus* Hüb., *T. siva* Edw., *Lycæna alce* Edw., *Nisoniades alpheus* Edw., *Eudamus tityrus* Fab., and *Pamphila cernes* B. and L. The last-mentioned species was taken at Rye.

## ZOOLOGICAL REGIONS.

Dr. C. H. Merriam has lately (Proc. Biol. Soc. Washington, April, 1892) published a new Bio-geographic map of North America, in which he adopts an arrangement of faunal regions different from

that of Packard (3d Rep. U. S. Ent. Comm.) and most other zoologists. In this new arrangement the old central region is abolished, and a new region, the Sonoran, is made to stretch from the Atlantic to the Pacific.

I have been interested in examining the facts presented in the present paper, and others known to me, to see how far they supported these changes. So far as I am able to judge, the suppression of the central region is entirely justified, but I cannot agree as to the proposed Sonoran region. An analysis of the insects of the Colorado Rocky Mountains shows that the high-alpine and mid-alpine elements, although sufficiently distinct, are both essentially boreal. If we follow Dr. Merriam's arrangement, it appears that the high-alpine is truly boreal, while the mid-alpine belongs to the transition region, containing a considerable number of strictly American types. The sub-alpine, on the other hand, is southern or Sonoran.

Dr. Horn has kindly given me his opinion, as follows:

"My ideas of the distribution of Coleoptera in the mountainous region of Colorado, which is a good centre of the Rocky Mountain chain are as follows:

"The high region seems to have been populated from the Canadian through the H. B. T. region. A collection made above 8000 feet in Colorado is almost identical with one made in the Lake Superior region. The same fauna runs down to N. M. and Arizona, and again appears, mixed, of course, in the Mexican Mountains.

"The sub-alpine region is one that continues from Washington to New Mexico, as shown by such striking forms as *Ergates*, *Melanophila miranda*, *Iphthimus serratus*, *Galeruca externa*, *Calosoma lunatum* in varieties.

"The lower region, foothills, etc., is a mixture of New Mexico forms with those of the eastern United States, with some peculiar forms allied more to the southern regions.

"California is a peculiar region, and, in many respects, allied to Europe (in general). I think California supplies us with more species of genera peculiar to Europe than does the Eastern region." (In litt., July 14, 1892.)

According to the facts now recorded it seems that there is, firstly, a circumpolar and strictly boreal element; secondly, a boreal but modified or Canadian element; and thirdly, a southern element belonging to the arid portion of Dr. Merriam's Sonoran region. I do not think any distinct faunæ except these can be recognized, and the central region accordingly falls. But there is, sprinkled among the ordinary types, a *distinct element of endemic species*, to which I shall refer later. There also seem to be a few surviving fragments of an ancient fauna, of which *Anthracopteryx* is a good example.

There seems to be a small Californian element, but the species

falling under this head are perhaps rather Southern than properly Californian. The Mollusca are very instructive here. There are certain distinct generic types of slugs, *Prophysaon* and *Hemphillia*, which belong to the Californian or Pacific province, and these go inland as far as Idaho. The *Nearctula* group of *Pupa*, which is boreal and Californian, extends southwards into the Colorado Mountains, with three species. The *Vertigo* group, on the other hand, is characteristic of the Eastern States, but I never found it living in Colorado. I did, however, find two species of this group, *P. ovata* Say* and *P. gouldii* Binn., in a post-tertiary deposit at West Cliff—a fact which I thought might have some significance. From these facts I infer that the fauna of the northern part of the Pacific region is pushing its way inland and southward, and will in the future mingle to some extent with that coming from the southern portion through Arizona.

The resemblance between the Colorado fauna, and that of the Mississippi basin and further East, always, excepting the boreal element that comes from the North, is very slight indeed. The great plains to the east of the Rocky Mountains have been as much a barrier as the sea would have been. Many insect pests of the East are only now reaching Colorado, having been taken there no doubt on plants. Sometime ago, in one of the Fort Collins Bulletins, it was noticed that certain Eastern pests occurred in the grounds of the Agricultural College, but not generally throughout the State. The reason of this was, I suppose, simply that they had been taken there on imported plants.

### REASONS FOR NOT ADOPTING THE SONORAN REGION.

In Dr. Merriam's map the Upper and Lower Sonoran regions include all of North America, except the boreal and transition areas to the North, and the tropical elements to the South. That is to say, the Pacific province is no longer recognized, and the Eastern and Central provinces, so far as they are not boreal, are merged together. It seems to me that the distribution of the Mollusca, more especially, precludes us from adopting this change. Take the slugs, for instance. Their distribution in the old regions (excluding species known to be imported) is as follows:

* Yarrow, in the Wheeler Report, records *P. ovata* from Twin Lakes and Saguache, but as he does not mention any of the *Nearctula* group, which he surely must have found, I suppose it likely that the identification is erroneous.

| Pacific Province. | Central Province. | Eastern Province. |
|---|---|---|
| Agriolimax, 2 spp. | Agriolimax, 1 sp. | Agriolimax, 1 sp. |
| Amalia, 1 sp. | | Philomycus, 5 spp. |
| Ariolimax, 2 spp. | | |
| Hesperarion, 3 spp. | | |
| Prophysaon, 6 spp. | | |
| Subg. Phenacarion, 2 spp. | | |
| Anadenulus, 1 sp. | | |
| Hemphillia, 1 sp. | | |
| Binneya, 1 sp. | | |

Of these, *Agriolimax*, *Ariolimax*, *Binneya* and *Philomycus* range into Central America. Four genera are peculiar to the Pacific province, two of them extending inland as far as Idaho. Not a single genus, except *Agriolimax*, which is cosmopolitan, extends across the continent.

The shell-bearing forms tell exactly the same story. In *Helix*, the group *Lysinoe*, with nineteen species, is confined to the Pacific province. On the other hand, the large and characteristic groups *Mesodon*, *Stenotrema*, *Triodopsis* and *Polygyra* belong to the Eastern province, with a very small representation in the West. Among freshwater forms, the extraordinarily rich fauna of the Eastern province finds no parallel in the West. To pursue this subject further would occupy too much space. I have used the Mollusca in illustration because they are little able to migrate, and present a more forcible instance than I could select in Entomology. But I should be sorry if these incomplete statements prevented any one from considering the matter impartially from other points of view.

## A METHOD FOR DEFINING FAUNAL REGIONS.

It appears from a consideration of what has been written on faunal regions, that it would be desirable if some rules could be laid down, so as to leave the matter less to the discretion of the individual writer. It would require a good deal of research to determine what rules could be laid down, that would work, but as regards insects, at all events, I have thought it possible that the following rule might answer for secondary faunal divisions:

*Any two districts shall be regarded as in the same secondary faunal division if the number of species common to both exceeds the number of genera in common.*

In order to test this rule, I have compared some orders of insects in the mid-alpine of Custer County with the lists in Prof. John B. Smith's New Jersey catalogue. According to accepted views, the

two regions are not in the same secondary division, but from the proximity of New Jersey to the boreal (or at least transition) zone, there should be a fair amount of affinity.

The results are as follows:

| Colo. (mid-alpine, Custer Co.) and N. J. | Genera in Common | Species in Common |
|---|---|---|
| Rhopalocera | 24 | 25 |
| Heterocera | 59 | 31 |
| Heteroptera | 36 | 27 |
| Homoptera | 14 | 4 |
| Orthoptera | 12 | 9 |
| | 145 | 96 |

The rule here gives just the results that might be expected. The greater number of butterfly *species* in common is in accordance with the wide distribution of Rhopalocera, as before mentioned.

It would be interesting to compare the mid-alpine and sub-alpine zones of Colorado in the same manner, but this cannot be satisfactorily done until the sub-alpine records are more complete. When comparing distinct faunæ in close geographical proximity, it would be necessary to exclude from consideration all casual occurrences of species out of their proper zone. The breeding areas are really what should be compared. This is sufficiently obvious; for instance it would be absurd, in such a comparison, to reckon such genera as *Junonia* and *Erebus* as inhabitants of the mid-alpine zone.

## EQUIGENERIC AREAS.

For minor divisions, to be used in relation to particular groups, I have devised what may be termed equigeneric areas.

*Equigeneric areas are areas throughout which the genera of the group under consideration are identical.*

These areas are sometimes large, sometimes small. When two genera overlap, the region where they both occur, however small, makes a separate equigeneric area. This might be thought a disadvantage; but really, I believe it to be an advantage in the method, since it is important to recognize these intermediate or overlapping areas.

Taking the slugs as convenient for illustration, the equigeneric areas in North America are as follows:

(1.) Area of *Agriolimax* only = boreal province (so far as slugs have been found) and central region.

(2.) Area of *Agriolimax* + *Philomycus* = Eastern province (*Veronicella* is found in Florida, and if truly indigenous there, as seems likely, constitutes another area).

(3.) Area of *Hemphillia* + *Prophysaon* + *Amalia*, etc. = Washington, Oregon and part of Idaho.
(4.) Area of *Ariolimax* + *Prophysaon* + *Phenacarion*, etc. = Puget Sound district and into Oregon.
(5.) Area of *Ariolimax* + *Prophysaon* + *Agriolimax* + *Hesperarion* + *Amalia* = Oregon and California, along the coast.
(6.) Area of *Anadenulus*, etc. = Cuyamaca Mountains, California.
(7.) Area of *Binneya* = Sta. Barbara Island, California.

These areas cannot in every case be precisely defined, owing to lack of information; but their utility seems to lie chiefly in the fact that they give results quite independent of any previous opinion or bias on the part of the collator.

## ORIGIN OF THE ROCKY MOUNTAIN FAUNA.

The numerous fossils of Colorado bear testimony to the fact that the region of the Rocky Mountains has in the past been peopled by a highly remarkable and numerous fauna. This fauna, however, does not appear to be ancestral to that of the present day. Nor has the present fauna any special connection with that of the high regions to the far South—the Andes. In order to arrive at just conclusions, it will be needful to consider these points in some further detail.

## ALPINE INSECTS OF THE ANDES.

The recently-published "Supplementary Appendix" to Mr. Whymper's work on his travels amongst the Andes of Ecuador, containing an account of his captures, includes some very valuable information about the insects of high altitudes in that country. The late Mr. H. W. Bates has written the introduction, in which the following passages occur:

"If there had been any distinct element of a North Temperate or South Temperate Coleopterous Fauna on the Ecuadorian Andes the collections he made, inexhaustive though they may be, would have shown some traces of it; but there are none. A few genera belonging to temperate latitudes, though not found in the tropical lowlands, do indeed occur, but they are forms of almost world-wide distribution in similar climates, and there is no representative of the numerous characteristic and common genera of the North or South. Even the Northern genera, more or less abundantly found on the Mexican highlands, are absent."

"One feature of the fauna is of great interest. It is the occurrence of apterous species of genera which at lower levels are always winged."

"It seems to me a fair deduction from the facts here set forth that no distinct traces of a migration during the lifetime of existing species, from North to South, or *vice versa*, along the Andes, have as yet been discovered, or are now likely to be discovered."

Going through the list of insects taken at high altitudes in Ecuador, the following points may be noted. There are four new species of *Pterostichus* from 12,000 feet and upwards, but they represent a new subgenus. There is not a single *Amara* or *Harpalus*. The two ants from 9000 feet or upwards, are *Camponotus sylvaticus* and a new *Pheidole*. Five Satyrinæ from 10,000 feet or upwards, are none of them of N. American genera. *Pyrameis huntera* was taken at 9800 feet. There are three species of *Lycæna* from over 10,000 feet. Three species of *Colias* are found at 10,000 feet or upwards; one, *C. alticola* Godm. and Salv., being especially characteristic of very high altitudes.

## FOSSIL INSECTS OF COLORADO.

From the elaborate researches of Mr. Scudder, we have a large mass of facts available concerning the tertiary insects of Colorado. As in the case of the living Andean fauna, we can detect no marked resemblance to the species now inhabiting the Rocky Mountains; and the indications are, that the recent fauna has *not* been derived from that preserved in the beds at Florissant and elsewhere. So far as modern genera are represented, they are certainly not alpine, but indicate a climate more like that of the Southern States.

Mr. Scudder's recent paper (Proc. Bost. Soc. N. Hist. 1892) on the Tertiary Rhynchophora brings out the facts of the case very clearly. The Gosiute fauna, from western Colorado, differs greatly from that of Florissant, no species being common to both; and of ninety-seven genera, only eighteen are common to the two faunæ. Yet these had hitherto been considered as belonging to about the same age.

All the species are extinct, and no species is identical with any European tertiary form. Many of the genera are extinct; existing genera are not infrequently now subtropical or tropical. There are no extinct families, but in one instance an extinct subfamily with numerous representatives.

Almost exactly the same results were obtained previously from a study of the tertiary Hemiptera, though at that time much less material from the Gosiute was available.

## THE GLACIAL EPOCH.

In order to account for the facts above cited, it is necessary to consider the geological history of America. In Prestwick's "Geology" (1888) there is a good account of what is known about the glacial

period. In America, the whole continent was covered with ice at least as far south as 40°, except a rather problematical area between the eastern and central regions. The ice-sheet went further south in the west than in the east, extending about to San Diego, though the basin of the Colorado in Arizona seems to have been free.

However, to the northwest there was apparently an unfrozen coast-line, at least as fertile as that of Greenland at the present day. We read that "the warm currents of the Pacific, which now temper the severity of the coast climate of Alaska, seem to have exerted the same influence during the glacial period, for none of the glaciers which descend from the inland range reach the sea, nor do they appear to have done so in glacial times. . . . The shores of British Columbia, on the contrary, are indented by long and deep fiords, through which, as in Norway and Greenland, the old glaciers, now stayed further in, traveled out to sea."

It can readily be imagined that such a state of affairs would lead to the destruction of a large part of the fauna, the remainder either surviving along the northwest coast-line, or going southward to the Gulf States and Mexico. The eastern fauna, with which we are not now particularly concerned, would largely survive, owing to there being a considerable area of unglaciated territory available. This, indeed, has been the case. The Californian fauna would survive in part to the north, and also in Lower California and the western coast region of Mexico. But the fauna of the central region would be almost annihilated, because the warm winds being cut off by the coast ranges, the country would become extremely cold, even far down into the higher lands of Mexico. The arid region where not actually glaciated would be a frozen desert, and the migration of the fauna southward would be far from easy.

In the eastern province the species of the moist Northern States would find little difficulty in migrating southward into the equally moist Southern States. The isotherms would shift southward over moderately uniform country. In the central region, however, this would not be the case. There is no place available to the South, except the moister coast line, and the interior uplands, which latter were undoubtedly glaciated. The great plains between the Rocky Mountains and the Mississippi would have made an impassable barrier for most species, preventing migration in that direction.

But, it may be urged, at *some* point to the southward the mountains or central uplands would cease to be glaciated, and why should

not migration take place into the neotropical region. That it did *not* take place, at all events beyond the isthmus, is evidenced by the facts above quoted from Mr. Whymper's "Appendix;" and the reason of this no doubt is, that the isthmus itself was submerged, and all connection between North and South America cut off. This question of the submergence of the Isthmus of Panama has been fully discussed by various naturalists, and need not be enlarged upon here.

It is impossible in the present paper to give more than this bare outline of the subject, but I believe the conclusion is justified, that the central region fauna was practically stamped out during the glacial epoch; and that the present fauna is derived from the boreal faunæ which survived to the east and to the west, and the southern fauna which survived in Mexico. This view seems to be supported by a consideration of the present distribution of species, as well as by geological evidence.

### REMNANTS OF THE ANCIENT FAUNA.

Mr. Scudder's tertiary insects of course date a long way back, and we have no knowledge of the entomology of Colorado immediately before the glacial epoch. But whatever it may have been like, it is reasonable to suppose that there would be some few survivors left, if we only knew which they were. I believe *Anthracopteryx hiemalis* is such a survivor; it is a peculiar species of wide affinities, the only representative of its genus; and moreover, it is not afraid of cold, appearing very early in the year. Among Lepidoptera, it may be that *Neophasia menapia* is a survivor, and also some of the high-alpine species. But this is mere speculation—it is enough to suggest the probability of such a thing.

### POST-GLACIAL DEVELOPMENTS.

Excepting the remnants of the ancient fauna, all the strictly endemic element in the Rocky Mountains is of *post-glacial origin*—that is, according to the views here set forth. This means a good deal, if it is actually the case, as I believe. Under certain circumstances, species develop quickly, and we have, at least among insects and flowering plants, a great array of new species coming into existence. Such species are closely allied to species from which they sprang, and to each other, so as to give rise to much dispute as to their validity—as an example, one may cite the genus *Argynnis*, which has been very productive of post-glacial species in America.

In such a case it matters little whether we term all these diverse forms true species, or subspecies or races,—but to lump them under a common name obscures the facts, and leads us to ignore one of the most interesting phenomena that are presented to a zoologist.

I was very well pleased to find these opinions shared by so acute an observer as Mr. Thos. E. Bean, of Laggan, Alberta. He wrote me on Dec. 6, 1892: "In answer to your query, I can say most decidedly that in my opinion the butterflies of this [Laggan] district may be arranged in two categories *as to their age as species:* one set of apparently *old old forms*, the others having the appearance of being *forms now taking character*. I have now under consideration one of the latter kind, a *Colias*, which, if completer study confirms my present views, I shall probably announce as a distinct species. In that case I may give it the name *post-glacialis*, in accordance with the idea that it is one of these recently separated species which have not yet acquired complete equilibrium of characters."

## SPECIES-FORMING AREAS.

It is well known that the genera commonly accepted are unequal in value, but most of those whose validity could not be questioned, are evidently of considerable antiquity. Of the forty-six genera of aculeate Hymenoptera in the mid-alpine of Custer County, thirty-three, or about two-thirds, are also found in the British Is. This is not very different from what might be expected; but the further wide distribution of some of these genera is shown when I open the volume of the "Zoological Record" for 1889, which happens to be at hand, and find references to *Megachile* from the Congo, *Andrena* from Sicily, *Trypoxylon* from Panama, *Ammophila* from Afghanistan, and so forth.

But the curious thing is, that these wide-ranging genera are not equally productive of species over their whole areas. Dr. Simroth has pointed out how in the case of the slug-genus *Agriolimax*, one or two species range almost unchanged over an immense territory; while in the Mediterranean region and the country eastward of it, species are produced in abundance. Dr. A. R. Wallace refers ("Island Life," ed. 2, p. 368) to the existence of four or five peculiar species of the moss-genus *Mnium* in the Drontheim Mountains in central Norway; these are "found nowhere else, although the genus extends over Europe, India, and the southern hemisphere, but always represented by a very few wide-ranging species except in this one mountain group!" Among flowering plants good instances can

easily be found. The British botanist, accustomed to two or three species of *Aster*, two of *Erigeron*, two of *Oxytropis*, and three of *Astragalus*, is astonished at the enormous species-fertility of these four genera in Rocky Mountains; while on the other hand a resident of Colorado, who is used to four species of *Rubus* and three of *Hieracium*, may well be startled to find that in the British Is. the *Rubi* are reckoned at something over sixty, and the *Hieracia*, given as forty in the last "London Catalogue," are still being added to at a quite remarkable rate by Mr. Hanbury!

Among insects, *Argynnis* and *Colias*, and several genera of Noctuæ, exhibit strong species-forming tendencies in the Western States of North America. *Catocala*, in the Eastern States, has a very strong species-forming area. And so on in many other instances which will occur to the reader. This phenomenon is a most remarkable one, since it affects chiefly old and almost cosmopolitan genera, and does not occur in the same districts in all the genera. Two cosmopolitan genera, as we have seen, may have their species-forming areas on opposite sides of the world. It would seem, indeed, as if there were causes at the bottom of it, that we do not yet understand.

## LIST OF SPECIES.

### COLEOPTERA.

#### CICINDELIDÆ.

1. Cicindela longilabris Say. Also high-alpine and Canada.
2. " sexguttata var. *patruela* Dej. East to New Jersey (Smith).
3. " repanda var. *oregona* Lec. Goes north to Stikine River and Glenora, B. C. (Wickham).

These are boreal forms. The absence of *C. punctulata* var. *micans* Fb., which one finds in the sub-alpine zone, is to be noted. Down at Canon City Mr. Wickham found *C. fulgida* Say, *C. vulgaris* Say, *C. scutellaris* Say, and also one of our mid-alpine species, *C. repanda* Dej., the specimens approaching the var. *oregona*. At Salida he took *C. formosa*. These facts, and others quoted below, are derived from a MS. list very kindly sent me by Mr. Wickham, of his captures at the following places:

Canon City, Colo., 5343 ft., May 11 to 14, 1891 (sub-alpine).
Salida, Colo., 7049 ft., May 15 to 16 (low mid-alpine).
Red Cliff, Colo., 8671 ft., May 16 (typical mid-alpine).

Canon City is only about twenty miles from Wet Mountain Valley. In several instances I have added to the records below the names of other species of the same genera found in the sub-alpine, etc. I place these in square brackets [ ] that there may be no confusion.

## CARABIDÆ.

4. Trachypachys inermis Motsch. North to British Columbia.
5. Carabus maeander Fisch. North to Canada.
6. " tædatus Fabr. Also sub-alpine. North to Canada.
7. " serratus Say. Also sub-alpine. North to Canada.
8. Notiophilus sibiricus Motsch. Recorded by Packard from Labrador.
9. Dyschirius truncatus Lec.
10. Bembidium nitidum Kirb. Also at Salida (Wickham).
11. " bimaculatum Kirb. North to Canada.
12. " lucidum Lec. North to Canada. Down to Salida and Canon City (Wickham).
13. Bembidium arcuatum Lec. Extends to Canada (Kilman, "Can. Ent." 1889, p. 109).
14. Bembidium indistinctum Dej. [At Canon City, Mr. Wickham found *B. lugubre* and *B. transversale*—but the latter also at Red Cliff.]
15. Tachys incurvus Say. East to Iowa (Wickham). Also at Salida (id.) [At Canon City, Mr. Wickham found *T. nebulosus*.]
16. Pterostichus longulus Lec. Also at Red Cliff (Wickham).
17. " luczottii Dej. West Cliff, April 5. Goes north to Glenora, B. C. (Wickham) and Labrador (Packard).
18. Amara laticollis Lec.
19. " latior Kirb. North to Canada and East to New Jersey.
20. " confusa Lec. Also Rio Grande (Henshaw).
21. " polita Lec. East New Mexico (LeConte).* Salida (Wickham).
22. " erratica Sturm.? *A. erratica* occurs in Canada.
23. " interstitialis Dej. Also sub-alpine. North to Canada.
24. " obesa Say. North to Canada.
25. " remotestriata Dej. (= *terrestris* Lec.). North to Glenora, B. C. (Wickham). Down to Canon City, where I found it.
26. " musculus Say. North to Canada.
27. " nupera Horn.
28. " chalcea Dej.?
29. Platynus affinis Kirb.? *P. affinis* occurs in Canada.
30. " sordens Kirb. N. to Canada. [At Salida Mr. Wickham found *P. placidus* and *P. errans*.]
31. Lebia vivida Bates.
32. " viridis Say. For a doubtful Canadian record see "Can. Ent." 1890. p. 153. E. to New Jersey (Smith). Down to Pueblo (4669 ft.).
33. Lebia furcata Lec., near Ula. I also found specimens which were thought to be *L. scapularis*, but they were probably only *furcata*.
34. Blechrus nigrinus Mann. West Cliff, May 25. E. to New Jersey (Smith).
35. Cymindis planipennis Lec., on the open prairie, March 30.
36. Agonoderus pallipes Fab. N. to Manitoba. Mr. Wickham found it at Albuquerque, N. Mex.
37. Harpalus retractus Lec. E. New Mexico (LeConte).
38. " amputatus Say. N. to Manitoba. Down to Denver (5196 ft.).
39. " nitidulus Chaud.? W. Cliff. *H. nitidulus* occurs in N. J. (Smith).

* East New Mexico. Species quoted from this locality by LeConte, Smiths. Contr. Knowl., 1859, pp. 52–58.

40. Harpalus ellipsis Lec.
41. " basilaris Kirb. N. to Canada. [At Canon City Mr. Wickham found *H. oblitus, H. lustrans* and *H. basilaris*.]
42. Stenolophus conjunctus Say. N. to Canada.
43. Tachycellus nigrinus Dej. N. to Canada.
44. " badiipennis Hald.

*Carabus maeander, Notiophilus sibiricus* and *Amara interstitialis* are boreal and Asiatic, while *Amara erratica* and *Blechrus nigrinus* are boreal and probably circumpolar.

Some species of *Anisodactylus* would probably be found on further search, though so far as I can gather, Colorado is poor in this genus. I found *A. nigrita* Dej. in Cottonwood Gulch, Saguache County; this is high up on the western slope of the Sangre de Cristo Range.

At Red Cliff, which is mid-alpine, though over one hundred miles from Wet Mountain Valley and on the Pacific slope, Mr. Wickham found fifteen Carabidæ, of which the following eleven are wanting in our district: *Calathus ingratus, Bembidium planatum, B. transversale, B. paludosum* var. *lacustre, B. maeklini, B. fugax, B. quadrulum, Amara impuncticollis, Pterostichus protractus, P. hudsonicus, P. mutus.*

At Salida, which is lower mid-alpine on the Atlantic slope, Mr. Wickham found thirteen Carabidæ, of which the following eight are wanting in our district: *Calosoma obsoletum, Nothopus zabroides, Harpalus oblitus, H. pennsylvanicus* var. *compar, Amara gibba, Platynus placidus, P. errans, Pterostichus orinomum.* These comparisons indicate more difference between the localities than I had quite expected, but perhaps the distinctions would appear less if fuller information were obtained.

## HALIPLIDÆ.

45. Haliplus ruficollis DeG. West Cliff.

The species is boreal, European and Asiatic.

## DYTISCIDÆ.

46. Laccophilus decipiens Lec. West Cliff.
47. Bidessus affinis Say. E. to New Jersey (Smith).
48. Deronectes catascopium Say.
49. Agabus intersectus Cr.
50. " parallelus Lec. Northeast to Labrador (Packard).
51. " morosus Lec.
52. " lecontei Cr.
53. " obliteratus Lec. Originally described from Fort Laramie. [At Canon City Mr. Wickham found *A. lugens*.]
54. Rhantus binotatus Harr. N. to Canada.

*Deronectes catascopium*, if considered specifically identical with *D. griseostriatus* DeG., is not only boreal in America, but extends to northern Europe and Siberia.

## GYRINIDÆ.

55. Gyrinus sp., West Cliff, April 16.

## HYDROPHILIDÆ.

56. Laccobius agilis Randall. E. to Iowa (Wickham) and New Jersey.
57. Philhydrus diffusus Lec. West Cliff.
58. Hydrobius subcupreus Say. West Cliff.

These three species all extend East to New Jersey. Three species found by Mr. Wickham at Canon City are all of genera different from ours. viz., *Limnocharis piceus*, *Cymbiodyta morata* and *Ochthebius interruptus*. It is significant that two of these genera, and all of the species, are absent from the New Jersey list.

## SILPHIDÆ.

59. Necrophorus marginatus Fab. N. to Canada.
60. " guttula Mots. (= *hecate* Bland). E. to New Jersey (Smith).
61. Silpha lapponica Herbst. Down to Denver (Wheeler Report).
62. " ramosa Say. Also plains S. of Denver (Wheeler Report). E. New Mexico (LeConte).

*S. lapponica* is boreal in all three northern continents.

## PSELAPHIDÆ.

I did not meet with any. In the sub-alpine, Mr. Wickham found a new *Bryaxis* (*B. wickhamii* Brendel MS.) at Canon City.

## STAPHYLINIDÆ.

63. Falagria dissecta Erichs. E. to New Jersey (Smith).
64. Aleochara bimaculata Grav., Willow Creek, Cusack Ranch. E. to New Jersey (Smith).
65. Heterothrops fumigatus Lec. West Cliff. E. to New Jersey (Smith).
66. Quedius prostans Horn.
67. Creophilus villosus Grav. This species goes North to Alaska (Wickham) and Newfoundland (Gosse), and was found by Gosse in Jamaica!
68. Philonthus æreus Rossi.
69 " furvus Nord. Also at Salida (Wickham) and Red Cliff (id.).
70. " puberulus Horn. West Cliff.
71. " ferreipennis Horn? West Cliff. [At Canon City Mr. Wickham found *P. virilis*, *P. microphthalmus* and *P. semiruber*.]
72. Xantholinus emmesus Grav. E. to New Jersey (Smith).
73. " obscurus Er. E. to New Jersey (Smith).
74. Stenus colon Say? *S. colon* occurs in Iowa (Wickham). [At Canon City Mr. Wickham found *S. incultus* and *S. dives*.]
75. Pæderus littorarius Grav., Ula, July 30, and common generally; West Cliff, April 5. N. to Canada. [At Canon City Mr. Wickham found *P. compotens*.
76. Tachyporus chrysomelinus L. Also at Red Cliff (Wickham). [*T. jocosus* is sub-alpine.]
77. Platystethus americanus Erichs. West Cliff. Also high-alpine, and N. to Glenora, B. C. (Wickham).
78. Oxytelus pennsylvanicus Erichs. West Cliff. N. to Canada.
79. " nitidulus Grav. Extends to Canada (Kilman) and is no doubt circumpolar.
80. Lomechusa cava Lec.

81. Anthobium sp. incert. Specimens with Dr. Horn and Dr. Hamilton.
82. Homalota sp. West Cliff.

*Philonthus æneus*, *Tachyporus chrysomelinus* and *Oxybeles nitidulus* are boreal and extend to Europe and Asia. The wide range of some species of this family is remarkable. The minute *Trogophlœus fulvipennis* Fauv., which I have taken in Jamaica (it also occurs in Cuba, etc.), is, according to Dr. Hamilton, the same as *T. corticinus*, which is found at 9200 ft. in Colorado and extends to Europe and Siberia.

## CORYLOPHIDÆ.

83. Sacium lugubre Lec.

## PHALACRIDÆ.

None found; at Canon City (sub-alpine) Mr. Wickham found *Olibrus apicalis*.

## COCCINELLIDÆ.

84. Næmia episcopalis Kirby. West Cliff.
85. Megilla vittigera Mann.
86. Hippodamia lecontei Muls. E. New Mexico (LeConte).
87. " convergens Guér., West Cliff, April 5. Also sub-alpine and high-alpine; a wide ranging species. E. to New Jersey.
88. Hippodamia spuria Lec. Hesterburg's Lane, Aug. 25.
89. " sinuata Muls.
90. " 13-punctata L.
91. " parenthesis Say, Ula, July 30. E. to New Jersey (Smith). Down to Pueblo.
92. Coccinella trifasciata L. Ula, July 30 (var.). Also taken near the Micawber Mine in October, in the high-alpine zone.
93. Coccinella 9-notata Herbst. Mr. Wickham took this in Alaska. Down to Pueblo (W. H. Hance, Wheeler Report).
94. Coccinella transversoguttata Fab. (= 5-*notata* Kirb.), West Cliff, May 23. Also high-alpine. Down to Canon City (Wickham).
95. Coccinella transversoguttata var. *transversalis* Muls.?
96. Coccinella sanguinea L. E. to New Jersey (Smith). This species also goes S. into the W. Indies; I took it at Barbadoes.
97. Harmonia picta Rand. Cusack Ranch (M. E. Cusack). North to Canada. Down to Colorado Springs (5992 ft.).
98. Mysia hornii Cr.
99. Anatis rathvoni Lec. var.
100. Psyllobora 20-maculata var. *tædata* Lec. This species goes N. to B. Col.
101. Hyperaspidius sp. incert., specimen with Dr. Riley.
102. Exochomus marginipennis Lec. E. to New Jersey (Smith).
103. Hyperaspis fimbriolata Mels. E. to N. Jersey (Smith). Down to Pueblo.
104. Scymnus lacustris Lec.

Some species of this family have a very wide distribution. *Hippodamia parenthesis* may not be specifically distinct from an Asiatic species. *H. 13-punctata*, *Coccinella 3-fasciata* and *C. transversoguttata* appear to be circumpolar.

## ENDOMYCHIDÆ.

105. Lycoperdina ferruginea Lec. E. to New Jersey (Smith).
106. Aphorista morosa Lec.

### EROTYLIDÆ.

107 Tritoma californica Lec., bet. Smith's Park and Wolff's Cabin, Aug. 25.

108. Erotylus boisduvali Chev. Denver to Georgetown (Wheeler Report). Santa Fé (LeConte). In our district it is not common; the highest altitude at which it was observed is on Short Creek, at the Cusack Ranch, where one specimen was taken by Mr. R. Cusack.

### CUCUJIDÆ.

109. Læmophlœus biguttatus Say. E. to New Jersey (Smith). E. New Mexico (LeConte).

### CRYPTOPHAGIDÆ.

110. Antherophagus convexulus Lec.

### DERMESTIDÆ.

111. Dermestes marmoratus Say. E. to Iowa (Wickham). Down to Denver. E. New Mexico (LeConte).

112. Dermestes fasciatus Lec., common. Down to Denver (Wheeler Report). E. New Mexico (LeConte).

113. Dermestes lardarius var. *signatus* Lec. [At Canon City Mr. Wickham found *D. murinus.*]

114. Perimegatoma cylindricum Kirby.

115. Attagenus piceus Oliv. (= *megatoma* Fab.). N. to latitude 54° 53′.

116. Anthrenus scrophulariæ L. E. to New Jersey.

*D. lardarius* is also European and Asiatic. *A. piceus* is a European insect, and so is *Anth. scrophulariæ.*

### HISTERIDÆ.

117. Hister subopacus Lec.

118. " sellatus Lec., near Ula.

119. " harrisii Kirb.

120. " depurator Say, Willow Creek, Cusack Ranch. N. to Canada.

121. " abbreviatus Fab, (= *bifidus* Say), West Cliff. N. to Canada.

122. Hetærinus morsus Lec., West Cliff.

123. Saprinus lugens Er., Willow Creek, Cusack Ranch. Down to Denver (Ulke, in Wheeler Report).

124. Saprinus oregonensis Lec., Willow Creek, Cusack Ranch. N. to Canada.

125. " fimbriatus Lec., Willow Creek, Cusack Ranch. [At Canon City Mr. Wickham found *S. ciliatus.*]

Mr. Wickham records fifteen Histeridæ from Iowa City and vicinity, not one of which is common to our region, so far as known.

### NITIDULIDÆ.

126. Carpophilus pallipennis Say, Ula, July 30. E. New Mexico (LeConte).

127. Epuræa labilis Er., on flowers of *Sambucus.* E. to New Jersey (Smith). [*E. papagona* is sub-alpine.]

128. Nitidula ziczac Say. E. to New Jersey (Smith).

129. Meligethes brassicæ Scop. (= *æneus* Fab.)

130. " mutatus Har., West Cliff, July 26, by sweeping.

131. Meligethes seminulum Lec., near West Cliff.

*M. brassicæ* is also Asiatic and European.

TROGOSITIDÆ.

132. Peltis pippingskoeldi Mann. Also at Red Cliff (Wickham).
133. Calitys dentata Fab., Short Creek, Cusack Ranch, Aug. 27. This species is also European.

PARNIDÆ.

134. Dryops striatus Lec. Also sub-alpine. E. to Iowa (Wickham).

DASCYLLIDÆ.

135. Eucinetus terminalis Lec. E. to New Jersey (Smith).
136. Cyphon variabilis Thunb., West Cliff, July 27. N. to Canada.

BYRRHIDÆ.

None found; but at Red Cliff, which is mid-alpine, Mr. Wickham found *Cytilus trivittatus*.

ELATERIDÆ.

137. Anelastes druryi Kirby. Also sub-alpine. Mr. Wickham found it at Albuquerque, N. Mex.
138. Megapenthes stigmosus Lec. Extends northward; found by Mr. Wickham at Port Chester, Alaska.
139. Dolopius lateralis Esch. Also high-alpine. N. to Canada. Down to Canon City (Wickham).
140. Anthracopteryx hiemalis Horn, West Cliff, common, crawling on the ground early in the year. Specimens are in U. S. Mus. and Brit. Mus.
141. Cardiophorus sp. incert. Specimen with Dr. Hamilton.
142. Corymbites conjungens Lec. [At Canon City Mr. Wickham found *C. maurus*.]
143. Cryptohypnus sp. nov. vel *hyperboreus?* Near Ula. Specimen with Dr. Hamilton.
144. Asaphes carbonatus Lec.

*A. hiemalis* is the only species of a remarkable genus, having characters allying it both to the Cryptohyprites and Corymbitites. Dr. Candéze states that it is allied to *Diadysis*, an Australian genus, and to the Patagonian *Asorno*. Thus, it has such peculiarities as we commonly notice in ancient types, verging on extinction. *Athous ferruginosus* is a boreal species which I found in the high-alpine, but not the mid-alpine region; it goes far North, Mr. Wickham found it in Alaska.

No doubt further search would reveal some more species of *Cryptohypnus* in our region. Mr. Wickham found *C. nocturnus* and *C. abbreviatus* at Red Cliff, which is mid-alpine.

BUPRESTIDÆ.

145. Dicerca prolongata Lec., Short Creek. N. to Canada.
146. Chalcophora virginiensis Drury, Cusack Ranch. Perhaps of the race *angulicollis*, which, as Dr. Hamilton informs me, is not specifically distinct.

147. Buprestis nuttalli Kirby, Willow Creek, Cusack Ranch. N. to Canada.
148. " maculiventris Say, Cusack Ranch (M. E. Cusack). N. to Can.
149. Melanophila longipes Say, common.
150. Agrilus torpidus Lec.

*C. virginiensis* is stated by Dr. Hamilton to be hardly or not specifically distinct from *C. mariana* of Europe. *M. longipes* is European and Asiatic—in short, circumpolar.

## LAMPYRIDÆ.

151. Eros aurora Hbst.
152. Ellychnia corrusca L., West Cliff, May 25. N. to Canada.
153. Pyropyga fenestralis Melsh., Ula, July 30.
154. Pyractomena borealis Rand., West Cliff, May 26; Cusack Ranch, June 18.
155. Chauliognathus basalis Lec., Beddoes' Old Ranch, Aug. 9. "Abundant near Fort Bridger and in the Black Hills" (LeConte).
156. Podabrus lateralis Lec. Also high-alpine. N. to Laggan, Alberta (Bean).
157. Silis munita Lec.
158. " difficilis Lec. E. New Mexico (LeConte).
159. Telephorus sp., West Cliff, July 27.

*Eros aurora* is circumpolar. It is interesting to note that near Iowa City, although Mr. Wickham records species of *Pyropyga*, *Pyractomena*, *Chauliognathus*, *Podabrus* and *Silis*, none of them are the same as ours. A species of *Chauliognathus* is fossil at Florissant.

## MALACHIIDÆ.

160. Collops vittatus Say, var. (or n. sp.?), West Cliff, July 26. *C. vittatus* occurs in Canada.
161. Malachius montanus Lec.
162. Listrus senilis Lec., West Cliff, July 27; Beddoes' Old Ranch, Aug. 9.

In Mr. Wickham's Iowa City list are three genera of this family; only one, *Callops*, is the same as ours, and then the species is different. Another Iowa City genus, *Attalus*, was found by Mr. Wickham in the sub-alpine at Canon City, the species being *A. basalis*.

## CLERIDÆ.

163. Trichodes ornatus Say, very common; June 3, on flowers of *Ligusticum montanum;* July 19, on *Geranium fremontii;* July 20, on *Achillea;* one on a flower of *Rosa blanda*, and many on yellow flowers, June 26.
164. Clerus sphegeus Fab., West Cliff, May 24 (Mrs. Chetelat). N. to B. Col.
165. Necrobia violacea L., very common. Specimens of what must have been this, I have formerly called *Corynetes cæruleus*, one having been so named for me.

*N. violacea* is circumpolar. *T. ornatus* goes north to Laggan, Alberta (T. E. Bean in litt.); southward, LeConte quotes it from E. N. Mexico.

*Trichodes ornatus*, as observed by me in our district, is constant in color, with yellow markings and the thorax blue. This is quite the same as *T. hartwegianus* White, the type of which I saw in the British Museum. Spinola's description of *ornatus* agrees with this form, but his figure shows the yellow less developed. *T. douglasianus* White from California, is a distinct form, both as to color and markings; the tho-

rax is green. In the British Museum, under *hartwegianus*, is another form in which the yellow markings are reduced, but tending to resemble those of *douglasianus;* the thorax is blue. This last is from Vancouver Island; the typical *hartwegianus* is from the Rocky Mountains, according to the label on the specimen, not California, as given in Gemminger and Harold's Catalogue, p. 1744. The original *ornatus* of Say is said to have come from Missouri.

## PTINIDÆ.

166. Ptinus sp. incert. Specimen sent to Dr. Riley.

## SCARABÆIDÆ.

167. Canthon praticola Lec., "Kansas and New Mexico" (LeConte, 1859).
168. Aphodius granarius L., West Cliff, May 7; April 30.
169. " vittatus Say, West Cliff. E. to New Jersey (Smith).
170. " brevicollis Lec.
171. " marginatus Lec., West Cliff.
172. " cruentatus Lec.
173. " explanatus Lec., vide Dr. Hamilton, "Can. Ent." 1891, p. 61.
174. " alternatus Horn, West Cliff, May 25.
175. Listrochelus sp. incert., specimen with Dr. Riley.
176. Trox sonoræ Lec.
177. Diplotaxis brevicollis Lec.
178. " subangulata Lec.
179. " pacata Lec.?
180. " haydenii Lec., West Cliff, May 23, etc., common at light, pale and dark forms occur. Sub-alpine in Pueblo County.
181. Lachnosterna crinita Burm. S. to Albuquerque, N. Mex. (Wickham).
182. Cremastochilus knochii Lec. E. to Iowa (Wickham).
183. Trichius piger Fab., on *Rosa*, etc. E. to New Jersey (Smith).
184. " texanus Horn, West Cliff, end of July; Beddoes' Old Ranch, Aug. 9 and Aug. 12.
185. Ligyrus lapponicus.

*Aphodius granarius* is circumpolar; surely native, not introduced, in Colorado. The genus *Diplotaxis* is absent from Mr. Wickham's Iowa City list, but the New Jersey list contains three species. This genus seems in the Rocky Mountains to partly take the place of *Lachnosterna*. At Salida, Mr. Wickham found *Cremastochilus crinitus* and *C. castaneæ*.

## SPONDYLIDÆ.

186. Spondylis upiformis Mann.

## CERAMBYCIDÆ.

187. Ergates spiculatus Lec. var. *marmoratus* Ckll. See "Ent. News" December, 1890, p. 161. A specimen is in British Museum.
188. Prionus californicus Mots., one specimen taken, now in British Museum.
189. Homæsthesis emarginatus Say, Willow Creek, specimen now in B. Mus.
190. Tragosoma depsarium L., subsp. *harrisii* Lec., Willow Creek, Cusack Ranch, Aug. (M. E. Cusack); also taken in September.
191. Asemum atrum Esch.

192. Nothorina aspera Lec.
193. Criocephalus agrestis Kirb. E. to New Jersey (Smith). Plains S. of Denver (Wheeler Report).
194. Criocephalus montanus Lec.
195. Hylotrupes ligneus Fab., several, now in Dr. Hamilton's coll.; the specimen formerly identified for me as *bajulus*, was probably *ligneus*. E. to New Jersey.
196. Phymatodes dimidiatus Kirb., dark var., West Cliff, June 11 (Mrs. Chetelat); and others taken at different times.
197. Callidium janthinum Lec.
198. " cicatricosum Mann., West Cliff, June 13.
199. Crossidius discoideus Say, Texas Creek. Splaun Ranch.
200. Clytus planifrons Lec., var. Short Creek, Cusack Ranch, Aug. 27.
201. Neoclytus muricatulus Kirb.
202. Atimia confusa Say, West Cliff, September, specimen now in British Museum. E. to New Jersey (Smith).
203. Rhagium lineatum Oliv., Splaun Ranch, April 26, the same day, it snowed. E. to New Jersey (Smith).
204. Pachyta liturata Kirb., immaculate var. Cusack Ranch (M. E. Cusack). The species goes N. to Stikine R., B. C. (Wickham).
205. Acmæops ligata Lec.
206. " proteus Kirb. Also high-alpine, and down to Denver (H. G. Smith, Jr.).
207. Acmæops pratensis Laich. Also high-alpine.
208. Leptura propinqua Bland, Beddoes' Old Ranch, Aug. 9; also high-alpine.
209. " subargentata Kirby. Also high-alpine, and goes N. to Glenora, B. C. (Wickham).
210. Leptura canadensis Fab., Cusack Ranch, Aug. 27. The species goes N. to Stikine R., B. C. (Wickham).
211. Leptura canadensis var. *cribripennis* Lec., Platte River (LeConte).
212. " chrysocoma Kirby, Cusack Ranch, Aug. 3.
213. Monohammus scutellatus var. *oregonensis* Lec. The species was found by Mr. Wickham at Stikine R., B. C. (Wickham).
214. Acanthocinus obliquus Lec., West Cliff, June 12 (Mrs. Chetelat).
215. " spectabilis Lec.
216. Pogonocherus mixtus Hald. E. to New Jersey (Smith).
217. " " var. *simplex*.

*Tragosoma depsarium* is doubtless circumpolar, as also is *Acmæops pratensis*, though neither are uniform throughout their range. Although Mr. Wickham quotes 28 genera and 42 species of Cerambycidæ from Iowa City and vicinity, only three of the genera (*Prionus, Acmæops, Leptura*) are common to the mid-alpine of Custer County, Colo., and not one species is common to both! Nevertheless, in Prof. Smith's New Jersey list are 15 genera and six species of Cerambycidæ common to our district.

## CHRYSOMELIDÆ.

218. Coscinoptera axillaris Lec.
219. " vittigera Lec., frequent; occurs on *Oxytropis lamberti*.
220. Babia quadriguttata Say, West Cliff, on *Yucca angustifolia*. E. to New Jersey (Smith).

221. Pachybrachys hepaticus Melsh. [At Canon City Mr. Wickham found *P. viduatus*.]
222. Adoxus vitis Fab., the black form. The species is also high-alpine.
223. Graphops varians Lec., common.
224. Entomoscelis adonidis Fab., Hesterburg's Lane, Aug. 25, on leaf of *Cuicus*.
225. Chrysomela flavomarginata Say, West Cliff, July 27.
226. " montivagans Lec.
227. Plagiodera oviformis Lec. N. to Vancouver Island (Wickham).
228. Luperus lecontei Cr.
229. Trirhabda flavolimbata Mann.?, abundant, larvæ on *Solidago missouriensis;* larva described as *flavolineatus* in West. Amer. Sci., 1889, p. 10.
230. Trirhabda convergens* Lec., near West Cliff, June 26, locally abundant, but not found where the var. *virescens* occurs.
231. Trirhabda convergens var. *virescens* Ckll., West Cliff, July 27, etc., very abundant; Silver Cliff; see "Ent. News," 1890, p. 4. A specimen is in the British Museum.
232. Adimonia americana var. *cribrata* Lec., Ula, July 30; West Cliff, May 25, ♂ and ♀ in cop. E. to New Jersey.
233. Galeruca decora Say, West Cliff. E. to New Jersey (Smith). [At Canon City Mr. Wickham found *G. erosa*.]
234. Monoxia guttulata Lec. Down to Pueblo (Wheeler Report).
235. Œdionychis lugens Lec. Originally described from Santa Fé.
236. Disonycha triangularis Say. Also sub-alpine. Colorado Springs (Wheeler Report).
237. Disonycha quinquevittata Say, West Cliff, abundant, flying in the sun by willow bushes.
238. Haltica evicta Lec., West Cliff.
239. " foliacea Lec. Also sub-alpine. Colorado Springs (Wheeler Rep.).
240. " punctipennis Lec., Smith's Park, Aug. 8, on *Epilobium angustifolium*.
241. Crepidodera helxines L., West Cliff.
242. Chætocnema subviridis Lec., Ula, July 30; West Cliff, July 27. Originally described from Fort Laramie.
243. Psylliodes interstitialis Lec. (= *convexior* Lec.)
244. Phyllotreta pusilla Horn, West Cliff, July 31; see also 8th Rep. Colorado Biological Association; also high-alpine.
245. Longitarsus nitidellus Ckll., Horn, two specimens taken, one now in Dr. Horn's coll., the other in U. S. Nat. Mus.
246. Phædon sp., see 12th Rep. Colorado Biological Association.

*Œdionychus lugens* is quoted by Horn from New Mexico and Arizona, and *Longitarsus nitidellus* has a like distribution. *Disonycha quinquevittata* appears to occur all over the Western States, and in a few of the Eastern; while, on the contrary, *D. triangularis* is Eastern and

* On reading Dr. Horn's recent revision of this genus, I have become doubtful whether the species I bred from *Solidago* was not really *T. convergens;* and also whether my *T. convergens* var. *virescens* is not rather a variety of *flavolimbata*. I no longer possess specimens of these insects, and cannot decide about their identification, but my var. *virescens* can be examined in the British Museum.

Canadian. *Haltica evicta* is quoted from Oregon; *H. punctipennis* goes East to Missouri and West to California. *Crepidodera helxines* is widely distributed and also European. *Chæt. subviridis* is found in Kansas, Montana, Arizona and California. *Phyllotreta pusilla* is widely distributed in the West, and a rather serious pest. *Psylliodes convexior* has a very wide distribution, mostly southern. Thus it is seen that our Halticini are derived from various sources, and by no means purely boreal.

*Adoxus vitis* (more properly called *obscurus* L.) is also European and Asiatic; so also is *Entomoscelis adonidis.*

## BRUCHIDÆ.

247. Bruchus fraterculus Horn.

## TENEBRIONIDÆ.

248. Emmenastus acutus Horn.
249. Embaphion sp. near *contusura* Lec. Specimen with Dr. Riley.
250. Asida opaca Say, "Kansas" [= Colorado] and New Mexico, near the mountains (LeConte, 1859). Denver (H. G. Smith, Jr.).
251. Asida sordida Lec. Also sub-alpine. Denver (H. G. Smith, Jr.).
252. " marginata Lec.
253. Iphthimus sp. incert. [At Canon City Mr. Wickham found *I. serratus.*]
254. Coniontis obesa Lec. Also at Salida (Wickham).
255. Conibius sp. incert. Specimen with Dr. Riley.
256. Eleodes tricostata Say, E. New Mexico (LeConte).
257. " obsoleta Say, West Cliff. Down to Pueblo (Wheeler Report). E. New Mexico (LeConte).
258. Eleodes extricata Say. Also sub-alpine. E. New Mexico (LeConte).
259. " nigrina Lec.. E. New Mexico (LeConte).
260. " hispilabris Say. In the Wheeler Report this is recorded from San Luis Valley, Fort Garland and plains S. of Denver.
261. Blapstinus lecontei Muls.
262. " pratensis Lec., "Platte River Valley, abundant" (LeConte).
263. " vestitus Lec., Platte River Valley (LeConte). [At Canon City Mr. Wickham found *B. dilatatus.*]
264. Paratenetus fuscus Lec. E. to New Jersey (Smith).

Of the above nine genera, the first seven are absent from the New Jersey list; and *P. fuscus* is the only species also recorded therein. Yet the Tenebrionidæ are well represented in New Jersey with thirty-one genera. In the Iowa City list there are eleven genera of Tenebrionidæ, only one of which, *Blapstinus*, is common to our district, and of this the species are different. Thus we see that both as to the forest Coleoptera (*e. g.* Cerambycidæ) and those of open ground (Tenebrionidæ) the fauna of our district is almost totally distinct from that in the vicinity of Iowa City.

*Trimytis pruinosa* was found by Mr. Wickham in the lower mid-alpine at Salida, and also in the sub-alpine at Canon City.

MELANDRYIDÆ.

265. Canifa sp. incert. Specimen with Dr. Riley.
266. Xylita lævigata Hellw.?
267. Lacconotus pinicolus Horn.
*X. lævigata* is also Siberian.

PYTHIDÆ.

268. Crymodes discicollis Lec

MORDELLIDÆ.

269. Pentaria sp. incert. Specimen sent to Dr. Riley.
270. Anaspis atra Lec.
271. Mordella melæna Germ. Also high-alpine. E. to New Jersey (Smith).
272. Mordellistena morula Lec. West Cliff, May 23.
273. " æmula Lec. West Cliff, May 23. Down to Pueblo (Wheeler Report). Platte River (LeConte).

*Anaspis rufa* Say, was not observed in the mid-alpine of Custer County, but I took it at the Micawber Mine in the high-alpine. It has a typically boreal distribution; in the east Dr. Hamilton informed me that it was common at Allegheny, Pa., and Prof. Smith records it from the Orange Mountains of New Jersey, while in the far northwest Mr. Wickham took it on flowers in Alaska.

ANTHICIDÆ.

274. Corphyra lewisii Horn.
275. Notoxus anchora Hentz, Ula, by sweeping, July 30. E. to New Jersey. Also in the Iowa City list.
276. Anthicus punctulatus Lec., frequent by Short Creek.
277. " sp. incert., near Ula. Specimen with Dr. Hamilton.
278. " haldemani Lec.

In the Iowa City list are two species of *Corphyra* and six of *Anthicus*, but all different from ours. At Salida Mr. Wickham found *Anthicus flavicans*.

MELOIDÆ.

279. Meloe carbonaceus Lec., rather common on the open prairie.
280. Tricrania stansburyi Hald.
281. Nemognatha lutea Lec., Texas Creek, Old Splaun Ranch, Aug. 12. Also in the Iowa City list.
282. Epicauta ferruginea Say. Also sub-alpine. Denver (H. G. Smith, Jr.).
283. " pennsylvanica DeG. Short Creek, Cusack Ranch, August. E. to New Jersey (Smith). Iowa City list (Wickham).
284. Cantharis nuttalli Say, very abundant. West Cliff, May 25; head of Grape Creek, fourteen miles from West Cliff (C. P. Lowe); Willow Creek, etc.
285. Cantharis viridana Lec.
286. " sphæricollis Say. Also in South Park (Wheeler Report).
287. " compressicornis Horn, on flowers of *Achillea millefolium*, Aug. 23. Down to Denver (H. G. Smith, Jr.).

Of the above five genera, only the first and fourth are common to New Jersey, and of the nine species, only one. New Jersey has only eight species of this family. In the Iowa City list there are four genera and eight species, of which three genera and two species occur with us.

It is rather remarkable that although LeConte's list from E. New Mexico contains thirteen species of Meloidæ, not one of the species is common to our district.

*Epicauta maculata* Say and *Nemognatha immaculata* Say, are two species characteristic of the sub-alpine zone, but not met with in the mid-alpine, according to my experience.

## RHYNCHITIDÆ.

288. Rhynchites bicolor Fab., abundant. West Cliff, June 17, on *Cnicus*. N. to Vancouver Island (Wickham).

## BYRSOPIDÆ.

Not met with; at Canon City (sub-alpine) Mr. Wickham found *Thecesternus humeralis*.

## OTIORHYNCHIDÆ.

289. Ophryastes tuberosus Lec., common. E. to New Mexico (LeConte).
290. Peritaxia rugicollis Horn.

Neither of these genera are in the Iowa City list. [At Canon City Mr. Wickham found *Ophryastes vittatus*.]

## CURCULIONIDÆ.

291. Sitones tibialis Auctt. This is also European and Asiatic.
292. Lepidophorus lineaticollis Kirby.
293. Macrops vitticollis Kirby.
294. Cleonus quadrilineatus Chev. [At Canon City Mr. Wickham found *C. canescens*.]
295. Smicronyx vestitus Lec. West Cliff, July 31. [*S. fulvus* is sub-alpine.]
296. Phyllotrox nubifer Lec. West Cliff, July 27.
297. " n. sp., sent to Dr. Hamilton, who says it is common in Colo.
298. Magdalis lecontei Horn. E. to New Jersey (Smith).
299. Anthonomus canus Lec. West Cliff, common.
300. " n. sp. a very downy little species, sent to Dr. J. Hamilton. [A species of *Anthonomus* is fossil at Florissant.]
301. Orchestes minutus Horn.
302. " rufipes Lec.
303. Acalles clathratus Lec.
304. Cœliodes curtus Say. E. to New Jersey (Smith).
305. Ceuthorhynchus n. sp. Specimen with Dr. Hamilton.
306. Baris transversa Say. [At Canon City Mr. Wickham found *B. tumescens*.]
307. Calandrinus grandicollis Lec.
308. Apion sp. West Cliff, July 27, by sweeping.

Of all these species only the first is on the Iowa City list, which nevertheless includes nearly seventy Curculionidæ!

CALANDRIDÆ.

309. Cactophagus validus Lec. See Sixth Rep. Colo. Biol. Assoc.

SCOLYTIDÆ.

310. Dendroctonus terebrans Oliv., quite common. Also sub-alpine in Custer County and in Pueblo County. E. to New Jersey (Smith).
311. Hylastes longus Lec.

Neither of these genera are on the Iowa list.

ANTHRIBIDÆ.

312. Gonotropis gibbosus Lec.

## NEUROPTERA.

TERMITIDÆ.

313. Termes flavipes Koll., honeycombs *Populus tremuloides*. E. to N. J. (Smith).

PERLIDÆ.

314. Leuctra sp.

EPHEMERIDÆ.

315. Callibaetis sp., near West Cliff.

ODONATA.

AGRIONINÆ.

316. Agrion (*sens. lat.*) sp., pale ochreous. West Cliff, May 25, locally abundant.
317. " " sp., thorax ochre, abdomen reddish and black above, near West Cliff, June 1.
318. Agrion (*sens. lat.*) sp., like the last, but scarcely any black on abdomen. West Cliff, June 12.
319. Agrion (*sens. lat.*) sp., thorax blue-black, hairy; abdomen dark reddish and black. West Cliff, by sweeping, June 12. On the underside of the thorax were very many small bright red mites.

HEMEROBIIDÆ.

320. Hemerobius sp., near West Cliff
321. Chrysopa sp., West Cliff, July.

PHRYGANIDÆ.

Some unidentified species were found.

## ORTHOPTERA.

MANTIDÆ.

322. Ameles (n. sp.?) juv., gray-brown, Old Splann Ranch, Texas Creek, 1889. Mr. Bruner wrote that it was rather like *A. mexicanus*, but not that.

LOCUSTIDÆ.

323. Ceuthophilus maculatus Harris, in a mine near Rosita (T. Charlton); see "Ent. News," 1890, p. 64. E. to New Jersey (Smith).

### ACRIDIDÆ.

The Acrididæ of the mid-alpine zone are almost entirely different from those of the sub-alpine; compare the present list with that given in "Entomologist," 1888, pp. 300–301.

324. Chrysochraon abdominale Thos.?, Willow Creek, Cusack Ranch, Sept.
325. Stenobothrus curtipennis Harr., West Cliff, July 27; Ula, July 30. Occurs throughout the United States and Brit. Am. (Bruner in litt.).
326. Melanoplus scriptus Walk. Extends northwestward (Bruner in litt.).
327. " femur-rubrum DeG. E. to New Jersey (Smith).
328. " gladstonii Riley. Plains near Rocky Mountains and N. to Saskatchewan (Bruner in litt.).
329. Melanoplus bivittatus Scudd. E. to New Jersey (Smith). United States and north Mexico (Bruner in litt.).
330. Chortophaga viridifasciata var. *infuscata* Harr. E. to New Jersey.
331. " " DeG., type form. E. to New Jersey.
332. Camnula pellucida Scudd. West Cliff, July 26; near Smith's Park, Aug. 25; Smith's Park, Aug. 6; near Smith's Park, Aug. 13. Occurs across the continent (Bruner in litt.).
333. Camnula pellucida var. *obiona* Thos.; see "Ent. Mo. Mag." Dec., 1888, p. 164. Mr. Bruner writes "hardly a variety—merely from high elevations."
334. Arphia teporata Scudd. Rocky Mts., 5000 to 9000 ft. (Bruner in litt.).
335. Hippiscus leprosus Sauss.?
336. Trimerotropis vinculata Scud. Rather widely distributed (Bruner in litt.).
337. Psolœssa coloradensis Thos. West Cliff, very abundant on dry bench above creek, May 5.
338. Circotettix verruculatus Kirby, type and var. E. to New Jersey. Rocky Mountains, high, and N. E. to Maine (Bruner in litt.).
339. Spharagemon æquale Scudd. E. to New Jersey. Rocky Mountains, lower than the last, and northeastward (Bruner in litt.).
340. Tettix acadicus ? Widely distributed (Bruner in litt.).
341. " granulatus Kirb. E. to New Jersey.
342. " ornatus Say. E. to New Jersey.
343. Acrolophus hirtipes Say. Lower Cox Ranch, Swift Creek, Aug. 25; near Beckwith Ranch, Aug. 9. Plains from Texas to Saskatchewan (Bruner in litt.).
344. Tettigidea sp.

## HYMENOPTERA.

### APIDÆ.

#### APINÆ.

345. Apis mellifica L., near Swift Creek.

#### BOMBINÆ.

346. Bombus sylvicola Kirby, Ula, a nest in stable at Howard Ranch, July 30; and Willow Creek, Cusack Ranch, August.
347. Bombus ternarius Say. Willow Creek, Cusack Ranch, Aug. 22. Also high-alpine, at timber line; goes S. to New Mexico (Wheeler Report).

348. Bombus dubius Cr., near Swift Creek.
349. " nevadensis Cr., near Swift Creek. Described in the Wheeler Report from Nevada, Arizona and New Mexico.
350. Bombus appositus Cr., near Swift Creek.
351. " mixtus Cr., near Swift Creek.
352. " perplexus var. *hudsonicus* Cr., Cusack Ranch, Aug. 3.
353. " borealis Kirby, Old Beddoes Ranch, Aug. 9, at flowers of *Rudbeckia laciniata*.
354. Bombus rufocinctus* Cr. West Cliff, May 25; Aug. 19, at flowers of *Gymnolomia multiflora*. Also high-alpine.

Of the nine Bombi, *sylvicola*, *ternarius*, *perplexus* and *borealis*, are boreal; *nevadensis* and *appositus* belong to the Western States; *rufocinctus* and *mixtus* are only known from Colorado; and *dubius* is from Kansas and Colorado. The case of *C. rufocinctus* is very remarkable, as it is an abundant and very distinct species, not easily overlooked. It has also a *Volucella*-mimic. Yet Mr. Fox tells me that it is still only known from Colorado.

ANTHOPHORINÆ.

355. Anthophora bomboides Kirby.
356. Diadasia australis Cr., near Swift Creek.
357. " enavata Cr. West Cliff, July 29.
358. Melissodes menuacha Cr. West Cliff, May 24; has blue-gray eyes.
359. Habropoda sp. West Cliff, May 23, at *Thermopsis*. A large dark bee with face partly light yellow.
360. Eucera sp. West Cliff, May 25; dark brown, with partly yellow face.

*Anth. bomboides* is boreal. *Diadasia* Patt. has three species, all found in Colorado. *D. australis* is also in Texas, and *D. enavata* in Kansas and Texas. *Melissodes* has fourteen species in Colorado. *M. menuacha* is widely distributed in the West. *Habropoda* is widely distributed in the United States, with few species; two occur in Colorado. *Eucera*, a genus also found in Europe, seems to have but one described species in the United States.

MEGACHILINÆ.

361. Megachile perbrevis Cr. Willow Creek.
362. " bucephala Sm. West Cliff.
363. Anthidium parvum Cr., near Swift Creek.
364. Monumetha borealis Cr. West Cliff, May 24; has blue-gray eyes.
365. Osmia densa Cr. West Cliff, May 25.
366. " integra Cr. West Cliff, May 19, two specimens.
367. " juxta Cr.? West Cliff, May 19.
368. " marginipennis Cr., near Swift Creek, obtained from pupa cells found.

* I had failed to notice that this species is recorded from near Ottawa, Canada, by J. A. Guignard (Can. Ent. 1886, p. 68). This record is important from our point of view, as it indicates that the species is of preglacial origin. It should be looked for on the mountains of New England.—T. D. A. C.—Nov. 8.

369. Cœlioxys coloradensis Cr., near Swift Creek.

*Megachile* has twenty Colorado spp.; *M. perbrevis* is also in Texas; *M. bucephala* is boreal and western. *Anthidium* has twelve Colorado spp.; *A. parvum* is also in Oregon. *Mon. borealis*, the only U. S. species, is boreal and widely distributed. *Osmia*, with twenty-five spp. in Colorado, presents a good example of the development of numerous species within the limits of an old and widely distributed genus. All of the above mentioned species seem to be, so far as known, confined to Colorado. *Cœlioxys* has nine Colorado spp.; *C. coloradensis* seems confined to Colorado.

NOMADINÆ.

370. Bombomelecta thoracica Cr. West Cliff. May 19.
371. Nomada americana var. *valida* Cr. West Cliff, May 24, at flowers of *Erigeron radicatus*.
372. Nomada parata Cr. West Cliff, May 19; some have the ends of the antennæ reddish, some have not.
373. Nomada fragilis Cr. West Cliff, May 19.
374. " morrisoni Cr. West Cliff, May 19.
375. Panurgus fimbriatus Cr. West Cliff, May 19, and May 25.
376. " rufocinctus Ashm. West Cliff. Hym. Colorado* p. 4.
377. " andrenoides Cr. West Cliff, May 19, at willow blossom.
378. " marginatus Cr. West Cliff, May 19.

*Bomb. thoracica*, the only species of its genus, at least in N. America, is western. *Nomada* has twenty-six Colorado spp.; *N. americana* is boreal, but the other three in the list seem confined to Colorado. *Panurgus* and *Nomada* are also European; the Colorado spp. of the latter genus are only seven in number; of the above four, *fimbriatus* and *rufocinctus* seem only known from Colorado; *andrenoides* is also in Texas, and *marginatus* is recorded from Kansas.

ANDRENIDÆ.

ANDRENINÆ.

379. Megacilissa monticola Ashm. MS.; see 10th Rep. Colo. Biol. Ass'n.
380. Cilissa trizonata Ashm., Hym. Colo. p. 6.
381. " erythrogaster Ashm., Hym. Colo. p. 6.
382. " nigrihirta Ashm., Hym. Colo. p. 6.
383. " albihirta Ashm., Hym. Colo. p. 5.
384. Nomia nortoni Cr. West Cliff, on flower of *Yucca angustifolia*. Also high-alpine, at timber line.
385. Andrena sp. West Cliff, May 24.

*Megacilissa* is quoted in Cresson's catalogue only from Georgia; but Mr. Fox informs me that there are two species in Mexico, and one in N. Mex. *Cilissa* has only one United States species, according to Cresson's work, but probably several exist; the genus is also European. Our four species are only known from Colorado. *Nomia nortoni* extends

* Hym. Colo. = Ashmead; on the Hymenoptera of Colorado. Bull. 1, Colo. Biol. Assoc., 1890.

to Kansas and Texas; and there is another of the genus in Nevada. *Andrena*, which is also European, has many North American species. Thus, of the above four generic types, two, *Megacilissa* and *Nomia* seem to belong to the Southern fauna; and the other two, to the boreal.

HALICTINÆ.

386. Prosopis varifrons Cr., Cusack Ranch, Aug. 3, and near West Cliff.
387. " basalis Sm., Cusack Ranch (M. E. Cusack). Also high-alpine.
388. Colletes sp. West Cliff, May 19.
389. Agapostemon sp. West Cliff, May 23, at flowers of *Ranunculus cymbalaria*, and May 25, at *Senecio* flowers, abundant. A bright green species.
390. A. melliventris Cr.? In September, as I was driving past Dismore's Ranch, just within the Custer County boundary, I saw a bee which seemed very like the figure of this species in the Rept. Wheeler Survey, which, as it happened, I had been looking at a few hours before. Unfortunately, I could not catch it.
391. Halictus sp. West Cliff, May 23, at *Ranunculus cymbalaria*.

*Prosopis varifrons* seems confined to Colorado, but *P. basalis* ranges to British America. *Colletes* is widely distributed from Canada to Florida, etc., besides being European. *Agapostemon* and *Halictus* go south to Florida, etc., but although there are many United States species of *Halictus*, none, except *trizonatus* from Nevada, seem to have been found on the Pacific slope.

*Sphecodes*, a boreal genus, was not noticed in the mid-alpine; but in the high-alpine region I met with *S. dichroa* Sm. In Europe this genus shows a tendency to become split up into numerous closely allied but distinct species, so that in the British Is. alone there are fifteen specific forms; in North America this species-forming tendency has not shown itself, so far as can be judged from published information, the whole of North America having but five species.

CRABRONIDÆ.

392. Crabro packardii Cr., near Swift Creek.
393. " vicinus Cr., near Swift Creek.
394. " bellus Cr., near Swift Creek.
395. " gracilissimus Pack., near Swift Creek.
396. " sexmaculata Say, Willow Creek, Cusack Ranch, Aug. 22.
397. Trypoxylon frigidum Sm., Cusack Ranch.
398. Oxybelus n. sp. Ashm., near Swift Creek.

*Crabro sexmaculata* is boreal, but the others are only known from Colorado. *T. frigidum* is also a boreal type. The genus *Oxybelus* is widely distributed in America, and has five Colorado species.

PEMPHREDONIDÆ.

399. Passalœcus mandibularis Cr., Cusack Ranch (M. E. Cusack); and near West Cliff. Also high-alpine.
400. Passalœcus cuspidatus Sm. West Cliff.
401. Cemonus inornatus Say, Cusack Ranch.
402. Stigmus fraternus Say. West Cliff, by sweeping, July 25.
403. Pemphredon concolor Say. West Cliff.

This is not a species-forming family, but its types are widely spread. There are only two North American genera not here represented, both belonging to the Northeastern States, and monotypic. *Passalœcus* (also European) is a boreal genus which has not split into many species; there is only one other in the United States besides the above, both of which extend to British America. *C. inornatus*, the only United States species of its genus, extends to Canada, and is widely distributed. The same applies to *Pemph. concolor*, except that there is a second species in Pennsylvania. *S. fraternus* goes to Canada, New York, Pennsylvania, and there is a different species in Illinois. There is no Colorado species of this family not found in Wet Mountain Valley, so far as known.

### NYSSONIDÆ.

404. **Hoplisus flavinotatus** Ashm. MS.; see 10th Rep. Colo. Biol. Asso'n.

*Hoplisus* is a widely distributed genus, also European.

The genus *Gorytes* is not in our list, and judging from Cresson's list, the species seem to come from the Southern and Eastern States. But Mr. Fox has lately described five new species from Western States (Nevada, Montana, Washington), showing that it will not do to theorise very much on present information, which is so liable to be upset by new discoveries

#### BEMBECINÆ.

405. **Steniolia obliqua** Say, Cusack Ranch (M. E. Cusack); West Cliff.

This species is given only for Colorado in Cresson's list, but I learn from Mr. Fox that it is found in British Columbia and Texas, and that there are three other American species.

#### NEOLARRINÆ.

406. **Neolarra pruinosa** Ashm., Hym. Colo., p. 8.

This insect was made the type of a new species, genus and subfamily by Mr. Ashmead, and is, I believe, still only known from the typical specimen, which is in the collection of its describer.

### LARRIDÆ.

#### LARRINÆ.

407. **Larra montana** Cr., Cusack Ranch (M. E. Cusack).

A widely distributed genus, but the present species seems confined to Colorado. There are four other Colorado species.

### SPHECIDÆ.

408. **Ammophila vulgaris** Cr. West Cliff, May 25.

409. " **robusta** Cr., Swift Creek, caught preying upon a *Clisiocampa* larva.

410. **Ammophila macra** Cr., Willow Creek, Cusack Ranch, Aug. 14.

411. " **luctuosa** Sm. West Cliff, May 23, 24 and 25.

*Ammophila*, also a European genus, is well represented in Colorado with nineteen species. *A. vulgaris* is also found in Texas, and so is probably a southern type; while *A. luctuosa* is boreal, and the other two seem peculiar to Colorado.

POMPILIDÆ.

412. Agenia congrua Cr., near Swift Creek.
413. Pompilus biguttatus St. Farg.
414. " scelestus Cr., near Swift Creek.
415. Priocnemis sp., near Swift Creek.

All three genera are also European. *Pompilus* is extremely rich in species, and widely distributed; eleven species occur in Colorado, both of those given above are boreal. *Priocnemis* has six Colorado species. *Agenia congrua*, the only Colorado species of its genus, is down in Cresson's catalogue only for W. Va., but possibly it will prove to be really boreal.

VESPIDÆ.

416. Vespa germanica Fb., near Swift Creek.
417. " maculata Fb., Willow Creek, Cusack Ranch, August. Extends to Labrador (Packard).
418. Vespa occidentalis Cr., near Swift Creek.
419. " diabolica Sauss., Cusack Ranch, Aug. 3.
420. " infernalis Cr., near Swift Creek.
421. Polybia sp. incert. Specimen with Dr. Riley.

The wasps are very similar to those of Europe, and *V. germanica* is specifically identical. *V. maculata*, *diabolica* and *infernalis* may be considered boreal, while *V. occidentalis* is western. For this last species Cresson cites Nevada and New Mexico, while Mr. Fox informs me that he has seen specimens from Washington and Vancouver Island. *Polistes* occurs immediately below the mid-alpine region, and I believe extends into it, but I have no records.

EUMENIDÆ.

422. Eumenes fraternus Say, near Swift Creek.
423. Odynerus walshianus Sauss., near Swift Creek.
424. " debilis Sauss., near Swift Creek.
425. " sulfureus Sauss., near Swift Creek.
426. " capra Sauss., near Swift Creek.
427. " tigris Sauss., near Swift Creek.
428. " albophaleratus Sauss., near Swift Creek.

Both the genera are also European, and all the species are boreal, except *O. walshianus*, known elsewhere only in Illinois; and *O. sulfureus*, which also occurs in California. Thinking that *O. walshianus* must surely have been found in some intermediate locality during recent years, I questioned Mr. Fox, and he assures me that this is not the case.

MUTILLIDÆ.

429. Photopsis alcanor Blake, near Swift Creek.
430. " glabrella Cr., near Swift Creek, etc., common. Also sub-alpine.
431. " atrata Blake, Willow Creek, Aug. 27, and near West Cliff.
432. Sphærophthalma mollissima Blake, Ula, July 30.
433. " creusa Cr., West Cliff, July 27.
434. " fulvohirta Cr., near Swift Creek.

*Photopsis* and *Sphærophthalma* are genera inhabiting the dry regions of the West, and extremely rich in species, which are closely allied to one another. *Eleodes*, among the Coleoptera, offers a similar instance. It is difficult to account for the origin of so many species under conditions which can hardly at any time have been very diverse. Mr. Fox writes me "no species of *Photopsis* is known further east than Colorado. *P. cressoni* Fox, from New Jersey, is a doubtful *Photopsis*. *Sphærophthalma* is found in all regions except the extreme North and South, and is especially well represented in the Tropics; it is not distinct from *Mutilla*." Three of the above species seem confined to Colorado, but of the other three, *P. alcanor* extends to Arizona, *P. atrata* to Nevada, and *S. creusa* to Texas.

## FORMICIDÆ.

435. Camponotus sylvaticus var. *vicinus* Mayr.* Also high-alpine.
436. Formica fusca L., common; Dora, March 27.
437. " integra Nyl., very abundant; West Cliff, March 29; Beddoes' Old Ranch, May; April 5; Dora, March 27. Also high-alpine.
438. Formica aterrima Cr., West Cliff, common by the water-works May 25.
439. " ciliata Mayr?, West Cliff, at flowers of *Yucca angustifolia*.
440. Lasius flavus DeG., West Cliff.
441. " sp.
442. " niger var. *alienus* Först., West Cliff.
443. Tapinoma sessile Say, near Swift Creek. Also high-alpine.

*Formica aterrima* and *F. ciliata* seem confined to Colorado, but for the rest the species are boreal, and three of them quite identical with European forms. *F. aterrima* is a conspicuous species, but Mr. Fox tells me that it is still apparently confined to Colorado. *F. integra* is very near the European *F. rufa*, but Mr. Fox says authorities are agreed in considering it distinct.

## MYRMICIDÆ.

444. Pogonomyrmex occidentalis Cr., West Cliff, July 27.
445. Myrmica scabrinodis var. *lobicornis* Nyl., Willow Creek, Aug. 27. Also West Cliff.
446. Monomorium sp.

The *Pogonomyrmex* is also found in Texas. *M. lobicornis* is also European.

## CHRYSIDIDÆ.

### CHRYSIDINÆ.

447. Chrysis clara Cr., N. to Wash. and S. to Arizona and Texas.
448. " pacifica Say, near Swift Creek, common. N. E. to Labrador.
449. " lateridentata Aaron, near Swift Creek. N. to Washington.
450. " cærulans Fab., near West Cliff. E. to New Jersey (Smith) and N. to Vancouver.

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* *C. sylvaticus* Oliv. was found by Mr. Whymper at 9000 feet in Ecuador. Mr. Cameron remarks that it "is very generally distributed over the old world, as well as in America."

ELAMPINÆ.

451. Hedychrum violaceum Brull., small var. Willow Creek, Cusack Ranch. N. to Canada.
452. Hedychridium viride Cr. E. to New Jersey region.
453. Notozus viridicyaneus Nort., near West Cliff. N. to Canada.

PROCTOTRUPIDÆ.*

BETHYLINÆ.

454. Bethylus pedatus Say. E. to Indiana.

PLATYGASTERINÆ.

455. Polygnotus error Fitch, West Cliff, bred from gall of *Cecidomyia salicis-brassicoides*. E. to New York.

BELYTINÆ.

456. Ismarus atropetiolatus Ashm., West Cliff, July 31. Hym. Colo. p. 11.
457. Psilomma coloradensis Ashm., Hym. Colo. p. 11.
458. Miota glabra Ashm., Hym. Colo. p. 12.
459. Anectata polita Ashm. MS.; see 3d Rep. Colo. Biol. Asso'n.
460. Xenotoma macrodyctium Ashm. MS.; see 3d Rep. Colo. Biol. Asso'n.
461. Zelotypa coloradensis Ashm., Hym. Colo. p. 12.

CYNIPIDÆ.

FIGITINÆ.

462. Figites coloradensis Ashm., West Cliff, June 11, by sweeping. Also high-alpine. Hym. Colo. p. 13.

INQUILINÆ.

463. Periclistus pirata O. S., West Cliff, bred from galls of *Rhodites ignota*. E. to Connecticut.
464. Periclistus fusi Ckll., bred from galls of *Rhodites fusiformans*, West Cliff. Tr. Ent. Soc. Lond. 1890, xvi–xvii (sine descr.)

CYNIPINÆ.

465. Diastrophus fusiformans Ckll., Ashm., near Swift Creek. Hy. Col. p. 13.
466. Rhodites rosæfolii Ckll., Ashm., West Cliff, common; see "Ent. Mo. Mag." 1889, July, p. 324; August, p. 363; "Entom." 1890, p. 74; "Psyche" 1889, p. 284. Specimens in U. S. Nat. Mus. and Brit. Mus. Manitou and near Fort Collins (Gillette).
467. Rhodites bicolor Harr., West Cliff, abundant. N. to Canada. Down to Manitou and near Fort Collins (Gillette).
468. Rhodites fusiformans Ckll., Ashm., West Cliff, abundant; see "Entom." March, 1890, p. 75; "Can. Ent." March, 1890, p. 56. Hym. Col. p. 14.

* I have just received (November 24th) Mr. Ashmead's monograph of N. A. Proctotrypidæ, wherein the species from Wet Mountain Valley are named as follows: 1, *Synopeas inermis* Ashm.; 2, *Miota glabra* Ashm.; 3, *Miota* (olim *Psilomma*) *coloradensis* Ashm.; 4. *Belyta monilicornis* Ashm.; 5, *Cinetus* (olim *Xenotoma*) *macrodyctium* Ashm.; 6, *Pantoclis* (olim *Zelotypa*) *coloradensis* Ashm.; 7, *Anectata polita* Ashm.; 8, *Spilomicrus* (olim *Ismarus*) *atropetiolatus* Ashm. The *Cinetus* is also known from Virginia, all the rest are known only from our district.

469. Rhodites tuberculator Riley, MS., Ckll., Swift Creek, abundant; see "West. Amer. Sci." April, 1888, p. 60.
470. Rhodites ignota O. S., West Cliff, abundant. E. to New Jersey region. Down to near Fort Collins (Gillette).
471. Rhodites polita Ashm., West Cliff, gall only observed. Also recorded from California and Dakota (Ashmead). Hym. Colo. p. 14.
472. Rhodites spinosellus Ckll., West Cliff, gall only observed; see "Entom." March, 1890, p. 75; "Can. Ent." 1890, p. 39. Also high-alpine.
473. Rhodites globosus Ckll., West Cliff, gall only observed; see "Entom." March, 1890, p. 75.

For further information about the distribution of *Rhodites* in Colorado, see Gillette "Ent. News," 1892, p. 246.

474. Holcaspis globulus Fitch. Galls on *Quercus undulata*, supposed to be this. The species *H. globulus* occurs in New York and Connecticut.
475. Dryophanta? sp., small pubescent galls on midrib of underside of leaf of *Quercus undulata*.

## UROCERIDÆ.

476. Urocerus flavicornis Fab., Ula (E. L. B. Howard). Also high-alpine and sub-alpine. Packard records it from Labrador.
477. Urocerus areolatus Cr., Willow Creek, Cusack Ranch, Aug. 14. S. to N. M.

## TENTHREDINIDÆ.

### XYELINÆ.

478. Xyela minor Nort., West Cliff, May. N. to Canada.

### TENTHREDININÆ.

479. Labidia opimus Cr., near West Cliff. N. to Vancouver Island.
480. Monostegia obscurata Cr., West Cliff, May 25, on herbage by the creek, abundant; Colorado only (Cresson, 1887).*
481. Monophadnus scelestus Cr., West Cliff, May 19, by sweeping *Thermopsis*; and Aldrich Ranch, on *Smilacina stellata*, June 1. W. to Nevada.
482. Dineura pallida Ashm., Hym. Colo. p 15.
483. Dolerus similis Nort., West Cliff, May 23 and 24; Aldrich Ranch, on low herbs, June 1. N. to Canada.
484. Dolerus bicolor Beauv., West Cliff, May 25. N. to Canada.
485. " abdominalis Nort., near Swift Creek. N. to Canada.
486. " aprilis Nort., West Cliff, May 19 and May 22; Aldrich Ranch, on low herbs, June 1. N. to Canada.
487. Messa salicis Ashm. (= *salicum* Ckll.), Freer Ranch, bred from larvæ on willow; see "Psyche" 1889, p. 284. Hym. Colo. p. 15.
488. Nematus concolor Nort., West Cliff; see "Entom." 1890, p. 282. N. to Canada.
489. Nematus lateralis Nort., near Swift Creek. E. to Maine.
490. Euura salicis-ovum Walsh, West Cliff, galls common, but fly not reared. Throughout Mississippi Valley and east; following distribution of *Salix cordata*, to N. H. (Marlatt in Howard litt.).

* (Cresson, 1887.) This citation, here and elsewhere in the paper, refers to Mr. E. T. Cresson's Catalogue of the Described Hymenoptera of America north of Mexico.

491. Phymatocera sp., West Cliff, May 19, by sweeping *Thermopsis;* a black species.

In the case of the *Messa*, it is difficult to say which name should be used. Only the larva was described as *salicum*, and when I published the notes in "Psyche" I supposed Mr. Ashmead would use the same name for the imago. A fuller description of the larva than that formerly given is appended.*

CIMBICINÆ.

492. Cimbex americana Leach, Short Creek, Cusack Ranch, larvæ; see "Can. Ent." 1890, p. 76. N. to Canada.

BRACONIDÆ.

BRACONINÆ.

493. Vipio coloradensis Ashm., two specimens taken, one now in U. S. Nat. Mus. and one in Brit. Mus.

HECABOLINÆ.

494. Cænophanes atrata Ashm., Cusack Ranch, Aug. 2. Hym. Colo. p. 16.
495. Lysitermus coloradensis Ashm. Also high-alpine.

DORYCTINÆ.

496. Doryctes sp., West Cliff.

HORMIINÆ.

497. Hormius americanus Ashm., Hym. Colo p. 16.

RHOGADINÆ.

498. Rhogas lectus Cr., near Swift Creek. E. to Illinois; see also "Insect Life" 1890, p. 351.
499. Rhogas intermedius Cr., near Swift Creek. N. to Canada.

SIGALPHINÆ.

500. Schizoprymnus fissilis Prov. (sub *Chelonus*), Cusack Ranch. Query recte *fissus*, a Canadian species.

CHELONINÆ.

501. Chelonus aculeatus Ashm., near West Cliff. Hym. Colo. p. 17.
502. " lævifrons Cr., Colo. only (Cresson, 1887).
503. " sericeus Say, Willow Creek, Aug. 27. N. to Canada.

MICROGASTERINÆ.

504. Apanteles læviceps Ashm., Hym. Colo. p. 17.
505. " sp., cocoons found on *Oxytropis lamberti.*

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* *Messa salicum.* Larva: about 20 mm. long; head shiny, black with a dull olive face; body light bluish green, dorsal vessel appearing as a darker green line. Laterally, on each body-segment, except the first and last, is a chrome-yellow patch; above each patch are three black spots (on some segments four), and below each patch four black spots, the upper anterior one being the largest. Anal plate blackish. Legs pale green, a blackish spot between most of the abdominal pairs. On willow, Freer's Ranch, June 12, 1888.

506. Apanteles sp., cocoon-cluster on *Potentilla fruticosa* Brock Ranch, Willow Creek.
507. Apanteles congregatus Say, near Swift Creek. N. to Canada.
508. Microgaster gelechiæ Riley. E. to Missouri.
509. Microplitis fuscipennis Ashm. MS.; see 10th Rep. Colo. Biol. Asso'n. This has not been described, Mr. Howard informs me.
510. Microplitis ceratominæ Riley. E. to Illinois.

AGATHIDINÆ.

511. Agathis vulgaris Cr. S. to Texas.

METEORINÆ.

512. Meteorus nigristigmus Ashm. MS.
513. " angustipennis Ashm. MS.* West Cliff.
514. " robustus Prov. N. to Canada.
515. " vulgaris Cr., West Cliff, July 26, by sweeping; Willow Creek, Aug. 27. N. to Canada.
516. Meteorus politus Prov., Cusack Ranch, Willow Creek, Aug. 2, etc., and near West Cliff. N. to Canada.
517. Meteorus gracilis Prov., West Cliff, by sweeping, July 25. N. to Canada.

DIOSPILINÆ.

518. Promachus n. sp., Ashm., near Swift Creek.

MACROCENTRINÆ.

519. Macrocentrus montivagus Ashm. MS.; see 10th Rept. Colo. Biol. Asso.
520. Zele melleus Cr., bet. West Cliff and Aldrich Ranch, June 1. S. to Tex.

ALYSIINÆ.

521. Pentapleura alticola Ashm., Hym. Colo. p. 18; see also 3d Rep. Colo. Biol. Asso.
522. Homophyla atrocoxalis Ashm., Cusack Ranch. Hym. Colo. p. 18.
523. Trachyusa americana Ashm. Hym. Colo. p. 18.
524. Adelura ampla Ashm. Hym. Colo. p. 19.
525. " montana Ashm. Hym. Colo. p. 19.
526. Diaspasta n. sp., Ashm. West Cliff.
527. " montana Ashm. MS., near Swift Creek.
528. " n. sp., Ashm.
529. Idiasta americana Ashm. MS.

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* *Meteorus angustipennis.* Mr. Ashmead identified a number of species for me, the names of which are followed by his authority, but of which I can trace no published record. I enter these with some hesitation, crediting them to "Ashm. MS." I have written both to Mr. Ashmead and Mr. Howard to gain information about them. Mr. Howard writes that he cannot tell whether they are published, as Mr. Ashmead has published so many short descriptive papers. Mr. Ashmead does not remember about them, and has not time to look them up. The Hymenoptera will be getting into a rather chaotic state, if authors cannot themselves tell what they have described. It is time for a supplementary catalogue.

DACNUSINÆ.

530. Cœlinius nigripes Ashm. West Cliff, by sweeping, July 25. Hym. Colo. p. 19.

APHIDIINÆ.

531. Praon coloradensis Ashm. Hym. Colo. p. 20.
532. " politus Ashm. MS.
533. Lysiphlebus salicaphis Fitch, West Cliff, July 31. Also high-alpine (as *salicaphidis* Ashm.). E. to New York.
534. Lipolexis chenopodiaphidis Ashm., Smith's Park, Aug. 6. Also high-alpine.
535. Lioplexis atriventris Ashm. MS., Smith's Park, Aug. 6. Also high-alpine.

## ICHNEUMONIDÆ.

ICHNEUMONINÆ.

536. Ichneumon corvinus Cr., Willow Creek, Cusack Ranch. N. to Canada.
537. " lætus Brull., bet. Micawber Mine and Smith's Park, Aug. 8. N. to Canada.
538. Ichneumon subfulvus Cr., Willow Creek, Cusack Ranch, Aug. 21. Colo. only (Cresson, 1887).
539. Ichneumon vultus Cr., Willow Creek, Cusack Ranch, August. Colo. only (Cresson, 1887).
540. Ichneumon longulus, Cr., between West Cliff and Aldrich, June 1. N. to Canada.
541. Nematomicrus coloradensis Ashm., Proc. U. S. N. M., xii, 395.
542. Phæogenes montivagus Ashm., Proc. U. S. N. M., xii, 394.

CRYPTINÆ.

543. Phygadeuon ater Ashm. Hym. Colo. p. 20.
544. " laticinctus Ashm. Hym. Colo. p. 21.
545. " montanus Cr., West Cliff, by sweeping, July 26. Colo. only (Cresson, 1887).
546. Cryptus persimilis Cr., near Swift Creek. N. to Canada.
547. " americanus Cr., near Swift Creek. N. to Canada.
548. " luctuosus Cr., West Cliff, June 6. Colo. only (Cresson, 1887).
549. " pumilus Cr., West Cliff, May 19. E. to Delaware.
550. Nematopodius orbitalis Ashm., near Swift Creek. Hym. Colo. p. 21.
551. Ischnocerus montanus Ashm., Proc. U. S. N. M. xii, 419.
552. " incertus Ashm. MS.
553. Orthopelma coloradensis Ashm., Proc. U. S. N. M. xii, 418.
554. " americana Riley; see "Insect Life" 1890, p. 154.
555. Hemiteles cincticornis Ashm., reared from *Apanteles læviceps* Ashm., Hym. Colo. p. 21.
556. Hemiteles alticola Ashm., Hym. Colo. p. 22.
557. " stigmatus Ashm., West Cliff. Hym. Colo. p. 21.
558. Pezolochus atratus Ashm., West Cliff. Hym. Colo. p. 22.
559. Catalytus americanus Ashm. MS.
560. Pezomachus pettitii Cr., amongst herbage near Grape Creek, West Cliff, October 6. N. to Canada.

OPHIONINÆ.

561. Ophion purgatum Say, near Swift Creek. N. to Canada.
562. " bilineatum Say, Willow Creek, Cusack Ranch. N. to Canada.
563. Nototrachys reticulatus Cr., near Swift Creek. Colo. only (Cress., '87).
564. Paniscus geminatus Say, between West Cliff and Aldrich Ranch, June 1; and Cusack Ranch, Aug. 3. N. to Canada.
565. Casinaria americana Ashm., Hym. Colo. p. 22.
566. Limneria macer Cr., West Cliff, May 25, Cusack Ranch, Aug. 2. Colo. only (Cresson, 1887).
567. Limneria montana Cr., Willow Creek, Cusack Ranch, Aug. 22. Also high-alpine. Colo. only (Cresson, 1887).
568. Limneria valens Cr., Ula, July 30. Colo. only (Cresson, 1887).
569. Mesochorus agilis Cr., West Cliff, July 27, by sweeping herbage. Colo. only (Cresson, 1887).
570. Banchus speciosus Cr., near Swift Creek. Named for me thus, but Mr. Howard suggests that probably *B. spinosus* was intended, as there does not seem to be any *B. speciosus* described by Cresson.

TRYPHONINÆ.

571. Orthocentrus trifasciatus Walsh, near Swift Creek. E. to Illinois.
572. Brassus tibialis Cr., near Swift Creek. N. to Canada.

PIMPLINÆ.

573. Ephialtes perlongus Cr., near Swift Creek. E. to Massachusetts.
574. Pimpla sexcincta Ashm., Hym. Colo. p. 24.
575. " texana Cr. S. to Texas.
576. " pedalis Cr. (or *tennicornis* Cr.?). West Cliff, July 27. N. to Canada.
577. " rubromaculata Ashm. MS., Ula, July 30.
578. Polysphincta burgessii Cr. N. to Canada.
579. Glypta varipes Cr., var. with shorter ovipositor, Willow Creek. Cusack Ranch, Aug. 14. Colo. only (Cresson, 1887).
580. Arenetra rufipes Cr., near Swift Creek. N. to Canada.
581. Phytodietus pleuralis Cr., Cusack Ranch. Colo. only (Cresson, 1887).
582. Euxorides americanus Cr., near Swift Creek. N. to Canada.
583. Odontomerus vicinus Cr. E. to Massachusetts.
584. Echthrus nubilipennis Cr. Colo. only (Cresson, 1887).
585. Meniscus sp., West Cliff.
586. Lampronota pleuralis Cr. N. to Canada.
587. " rufipes Cr. N. to Canada.
588. Thalessa lunator Fab., not observed by me, but Mr. E. L. B. Howard described to me an insect he had seen at Ula, which may have been this. N. to Canada; also in the sub-alpine zone.

EVANIIDÆ.

589. Gasteruption occidentale Cr., near Swift Creek. Colo. only (Cress., '87)

CHALCIDIDÆ.

Finding that several of the genera found in Custer County did not appear to be known in North America outside of Colorado, I sent a list of such to Mr. L. O. Howard, who has kindly replied as follows:

"The genera mentioned are all widespread, and by no means confined to the mid-alpine fauna. The study of the Chalcididæ is, in fact, so little advanced that we are in no position for generalizations like those which you wish to make. I doubt, in fact, whether one-fiftieth of our species in this family have as yet been described!" (*in litt.* Jan. 12, 1893.)

To this Mr. Howard adds statistics regarding the genera supposed to be only known from Colorado, and as the information embodied in these is new and valuable, I give it under the several subfamilies, although, to use an Irish expression, it only proves that it doesn't prove anything.

EUCHARINÆ.

590. **Stibula montana** Ashm., West Cliff, July 27, by sweeping herbage. As yet only known from Custer County, Colorado. There is a species of *Stibula* in Virginia, but the genus is otherwise South American. Hym. Colo. p. 24.

EURYTOMINÆ.

591. **Eurytoma bigeloviæ** Ashm., West Cliff, bred from galls of *Trypeta bigeloviæ*. Hym. Colo. p. 25.

592. **Eurytoma diastrophi** Walsh, West Cliff, bred from galls of *Rhodites ignota*, *Rhodites fusiformans* and *R. bicolor*. Also high-alpine. N. to Canada.

593. **Eurytoma studiosa** Say, West Cliff, bred from galls of *Cecidomyia* n. sp. near *hordeoides*, Walsh. N. to Canada.

594. **Isosoma hordei** Harr., var. West Cliff, July 31; the variety with pale legs, ♂. N. to Canada.

TORYMINÆ.

595. **Monodontomerus montivagus** Ashm. Also in California, parasitic on bees (see "Insect Life" 1892, p. 141). Hym. Colo. p. 25.

596. **Syntomaspis leucopus** Ashm. MS., West Cliff, July 27, by sweeping herbage.

597. **Syntomaspis lazulella** Ashm.

598. " **cupeipes** Ashm., West Cliff, July 27, by sweeping herbage.

599. " **monticola** Ashm. MS.; see "Ent. News" 1890, p. 79.

600. **Torymus chrysochlora** O. S., West Cliff, bred from *Rhodites fusiformans* gall. Also in the N. E. States.

601. **Torymus rudbeckiæ** Ashm., West Cliff, bred from an undetermined gall, supposed to be Cynipid. Hym. Colo. p. 26.

602. **Torymus magnificus** O. S., West Cliff, bred from *Rhodites bicolor* galls. E. to Connecticut.

603. **Torymus cyaneogaster** Ashm. MS., Ula, July 30.

604. " sp., bred from galls on willow; see "Entom." 1890, p. 282.

605. " n. sp., Ckll., bred from gall of *Cecidomyia alticola*.

606. " sp., West Cliff, May 19, by sweeping *Thermopsis;* brilliant blue-green, with a long, straight ovipositor.

TRIDYMINÆ.

607. **Tridymus cobaltinus** Ashm. MS., West Cliff, by sweeping herbage, July 27

Mr. Howard writes, "we have species of *Tridymus* from Richfield Springs, N. Y., the elevation of which I should estimate at 1000 feet, and from Washington, D. C., where, as you know, we are not over 200 feet above sea-level."

PTEROMALINÆ.

608. **Rhopalicus coloradensis** Ashm. Hym. Colo. p. 27.

609. **Dipara latipennis** Ashm., near West Cliff. Hym. Colo. p. 26.

610. **Eutelus** sp., West Cliff, bred from galls of *Cecidomyia s.-brassicoides;* see "Entom." 1890, p. 282.

611. **Eutelus flavipes** Walk.?, West Cliff, bred from an undetermined gall on a species of *Compositæ*. Hym. Colo. p. 27. *E. flavipes* was described from England.

612. **Habrocytus rosæ** Ashm., West Cliff, July 26, by sweeping, and bred from galls of *Rhodites fusiformans* and *R. ignota;* also captured at Cusack Ranch, Aug. 2, and Smith's Park, Aug. 6.

613. **Habrocytus obscuripes** Ashm., West Cliff, bred from *Rhodites bicolor* galls, May; also from galls of *Rhodites ignota*. Hym. Colo. p. 27.

614. **Cecidostigma megastigma** Ashm. MS., Smith's Park, Aug. 6. Presumably should be *Cecidostiba*.

615. **Glyphe flavipes** Ashm. MS., Hugg Ranch, Aug. 9; bright green with triangular abdomen.

616. **Glyphe viridicyaneus** Ashm. MS., Smith's Park, Aug. 6.

617. **Stenomalus muscarum** Walk., West Cliff, July 26, by sweeping, ♂. This species, Mr. Howard informs me, was described from England.

618. **Amblymerus productus** Ashm., Ula. July 30.

619. **Meraporus monticola** Ashm. MS., Cusack Ranch, Aug. 2 and 3; and near West Cliff.

620. **Platytermus citripes** Ashm. MS., West Cliff, July 27, by sweeping herbage.

*H. rosæ* has been bred from a gall collected in British Columbia; see "Can. Ent." 1890, p. 56.

Mr. Howard writes: "Of *Rhopalicus* we have one species from eastern Tennessee at a point the elevation of which is about 1500 feet; of *Habrocytus* we have two species from Washington, D. C., one from Los Angeles, Cala. (elevation 500 feet), one from Virginia (elevation about 500 feet); of *Platytermus* we have one species from Albany, N. Y. (elevation 500 feet), one from Alameda, Cala. (elevation about 100 feet), and one from Nevada County, California (elevation about 3000 feet); of *Amblymerus* we have one species from Virginia; of *Stenomalus* we have one from District of Columbia, one from Agricultural College, Michigan (elevation 500 feet), one from Virginia, and one from Alameda, Cala.; of *Cecidostiba* we have one from Pine Canon, California (elevation not known); of *Meraporus* we have one species from the District of Columbia, one from Virginia, one from Athens, Ga. (elevation 500 feet), one from Los Angeles, Cala., one from Agricultural College, Michigan, one from eastern Tennessee (elevation 1500 feet), and one from San Bernardino County, California (probably about 1500 feet to 2000 feet)."

ENCYRTINÆ.

621. **Homalotylus bifasciatus** Ashm., taken in August. Hym. Colo. p. 28.

622. **Encyrtus sulcatus** Ashm. MS., West Cliff, July 27, by sweeping herbage.

623. " **subauratus** Ashm. MS., West Cliff, July 27, by sweeping herbage.

624. **Encyrtus subopacus** Ashm. MS., West Cliff, July 27, by sweeping herbage.

TETRASTICHINÆ.

625. Tetrastichus rosæ Ashm., West Cliff, bred from galls of *Rhodites bicolor*. S. E. to Florida.

626. Tetrastichus sp., bred gall of *Cecidomyia s.-batatas*.

## LEPIDOPTERA.

### PAPILIONIDÆ.

PIERINÆ.

627. Neophasia menapia Feld., Beddoes' Old Ranch, Aug. 25; N. to Washington, where it occurs at 1900 feet (Stretch), and Vancouver Island.

628. Pieris sisymbri Bdv., Cusack Ranch, May 12; see also 6th Rep. Colo. Biol. Asso'n. W. to California and S. to Arizona.

629. Pieris protodice B. and L., West Cliff, May 25; April 15; June 26, common. N. to Canada.

630. Pieris oleracea Bdv., near Swift Creek, May 9. N. to Canada.

631. " " form *hiemalis* Harr.

632. Nathalis iole Bdv., near Swift Creek, June 17; two forms, *aureomaculata* and *flavomaculata*; see 4th Rep. Colo. Biol. Asso'n.

633. Anthocharis ausonides Bdv., Rosita (Nash); near Cusack Ranch, June 19; at rest on *Gilia*, May 24; June 26. N. to Alaska.

634. Callidryas eubule L., Rosita (Nash). A southern species, with individuals straggling northward; the genus has migratory tendencies.

635. Colias meadii Edw., Rosita (Nash). Really a high-alpine species. N. to Montana and S. to New Mexico.

636. Colias eurytheme Bdv. N. to Canada.

637. " " var. *autumnalis* Ckll., West Cliff, May 23, at flowers of *Thermopsis*. A specimen in Brit. Mus.

638. Colias eurytheme var. *eriphyle* Edw.

639. " " var. *intermedia* Ckll., West Cliff, May 25; May 19.

640. " " var. *keewaydin* Edw.

641. " " form *pallida* Ckll., West Cliff, May 19, etc.; see "West Amer. Sci." November, 1887, p. 217.

642. Colias alexandra Edw., Cusack Ranch, Aug. 3; below Micawber Mine, Aug. 8; Beddoes' Old Ranch, Aug. 15; flying abundantly, June 20; July 9. N. to Canada.

643. Terias nicippe Cram., June 17, by Swift Creek. A southern species, but E. to Pennsylvania. Down to Pueblo County (Nash).

A third species of *Colias*, *C. scudderii* Reak., was taken in the high-alpine zone, but not lower. *Nathalis iole* is a species of the plains, essentially southern, but going quite high in the Rocky Mountains, even up to the lower portion of the high-alpine zone.

The Pierinæ of our region show clearly a mingling of the boreal and southern faunæ.

PARNASSIINÆ.*

644. Parnassius smintheus Dbl. and Hew., near Cusack Ranch, June 19; Oak Hollow, June 26. The species goes N. to Canada.†

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* = *Parnassiidæ*, Elwes, P. Z. S., 1886, p. 18.

† Canada. Here and elsewhere in the paper, used in the wide sense, as including "British America."

PAPILIONINÆ.

645. Papilio rutulus Bdv. N. to British Columbia.
646. " asterias Fab. U. S. generally, and in Canada.
647. " zolicaon Bdv., Rosita (Nash). A Californian type; see "Papilio," 1883, p. 54, et seq. N. to Montana, S. to Arizona.
648. Papilio philenor L., Rosita (Nash). U. S. generally, and Canada. Arizona (W. H. Edw., "Papilio" 1882, p. 28).

*P. rutulus* and *asterias* were common, but I never myself saw *zolicaon* or *philenor*. *P. zolicaon* is an alpine insect, having been taken by the late Mr. Foster in the high-alpine at Marshall Pass. *P. philenor*, on the other hand, seems to be sub-alpine or hardly alpine; Mr. Nash took it also at Pueblo. *P. nitulus* has a wide range in altitude, going into the high-alpine; and down to Trinidad (Colo.), where it was found by Mr. Nash, and Denver (H. G. Smith, Jr.).

NYMPHALIDÆ.

EUPLŒINÆ.

649. Danais plexippus L., June 18; May 14; April 24 (R. Cusack); July 19, at flowers of *Oxytropis lamberti* and *Trifolium pratense;* July 20, at flowers of *Gilia*.
650. Danais berenice Cram., Rosita (Nash); near Ula, June 26.

*D. plexippus* goes N. to Canada, and S. into the neotropical region. *D. berenice* extends southward.

NYMPHALINÆ.

651. Agraulis vanillæ L., Rosita (Nash). It was in 1880 that Mr. Nash took this and *C. eubule*, both southern species, at Rosita.
652. Euptoieta claudia Cram. Also sub-alpine. Properly a southern species, but E. to New York, and has occurred in Canada.
653. Argynnis cipris Edw. N. to Montana, S. to Arizona.
654. " myrina Cram., near Taylor Creek, June 9 (Nash). N. to Alaska

I took some other Argynnids, but they were sent to Mr. Elwes, who did not identify them for me.

655. Melitæa minuta Edw., near Wolff's Cabin; June 26. S. to Arizona and New Mexico.
656. Melitæa nubigena Behr., Rosita (Nash). N. to Montana, W. to California. S. to New Mexico.
657. Phyciodes nycteis Dbl. N. to Canada.
658. " tharos Drury, Rosita (Nash). N. to Canada.
659. " camillus Edw. Has a wide range in altitude, high-alpine to sub-alpine. N. to Montana, E. to Kansas.
660. Phyciodes vesta Edw., Rosita (Nash). S. to Texas. Also taken by Mr. Nash at Pueblo.
661. Grapta zephyrus Edw., Rosita (Nash). Swift Creek. N. to Montana, S. to Arizona, W. to California.
662. Vanessa antiopa L., West Cliff, May 19; April 14; April 1; March 29; near Swift Creek, June 17. Also European.
663. Vanessa milbertii Godt., May 8; April 14; April 13. N. to Canada.
664. " " var. *subpallida* Ckll., West Cliff, May 19; see also "Entom." July, 1889, p. 185.

665. Vanessa californica Bdv., Rosita (Nash). Also in Oregon, Nev. and Cal.
666. Pyrameis atalanta L., Beddoes' Old Ranch, Aug. 9; near West Cliff, April 28; Swift Creek, May 13. Also European.
667. Pyrameis huntera Fab., becoming common on June 27. "North America generally" (W. H. Edwards).
668. Pyrameis cardui L., West Cliff, May 23; May 19; April 28, very abundant; April 23; at flowers of *Mertensia*, May 16.
669. Pyrameis cardui form *minor* Ckll., near Conway Ranch, June 26.
670. Junonia cœnia Hbn., Rosita (Nash). A southern type, but has been taken in Maine and Ontario.
671. Limenitis weidemeyerii Edw., Beddoes' Old Ranch, June 26. Extends up to timber line, and down to the sub-alpine. N. to Montana, S. to Arizona.

Mr. Nash informed me that he took *Argynnis helena* Edw., *A. electa* Edw., *A. hesperis* Edw. and *A. eurynome* Edw., at Music Pass. This is in Custer County.

SATYRINÆ.

672. Cœnonympha ochracea Edw., near Taylor Creek, June 9 (Nash); near Oak Hollow, June 26. N. to Canada, S. to Arizona.
673. Hipparchia ridingsii Reak., abundant. June 26. N. to Montana.
674. Satyrus charon Edw., Rosita (Nash); I also met with the species. N. to Canada.
675. Chionobas chryxus Westw. and Hew., Rosita (Nash). Goes up to timber line, where it is chiefly found. N. to Canada.
676. Chionobas uhleri Reak., Rosita (Nash); near Swift Creek. N. to Mont.

*Erebia epipsodea* Butl. was taken by Mr. Nash at Music Pass.

## LYCÆNIDÆ.

LEMONIINÆ.

677. Lemonias cythera Edw., Rosita (Nash). Mr. Nash also found it at Music Pass. S. to Arizona. Another species of the genus, *L. nais* Edw., occurs in Colorado, and was found by Mr. Nash in Hardscrabble Canon.

LYCÆNINÆ.

678. Thecla augustus Kirby, Willow Creek. N. to Canada.
679. " behrii Edw., Rosita (Nash). W. to California.
680. " eryphon Bdv., Rosita (Nash). W. to California.
681. " dumetorum Bdv., Rosita (Nash). Also in Oregon and Nevada.
682. Chrysophanus thoe B. and L., Rosita (Nash); West Cliff, July 26. N. to Canada.
683. Chrysophanus helloides Bdv. Also high-alpine, frequent. N. to Montana, W. to California. Rosita and Music Pass (Nash).
684. Chrysophanus sirius Edw., Rosita (Nash). N. to Canada, S. to Arizona.
685. Lycæna lycea Edw., Rosita (Nash); near Swift Creek. N. to Montana, S. to Arizona.
686. Lycæna sæpiolus Bdv., Rosita (Nash); I took it both in the mid-alpine and high-alpine zones. N. to Canada.
687. Lycæna oro Scudd., West Cliff, May 23. Also high-alpine; also in New Mexico and California.

688. Lycæna rustica Edw., Rosita (Nash). I took it in Saguache and Summit Counties. N. to Canada.
689. Lycæna battoides Behr., near Swift Creek. Also in California and Nev.
690. " melissa Edw., Rosita (Nash); near Swift Creek. F. to Montana, E. to Kansas, S. to Arizona.
691. Lycæna sagittigera Feld., Rosita (Nash). Also in Nevada and Cala.
692. " acmon Dbl. and Hew., West Cliff, May 25, on dry bench above creek; also high-alpine. N. to Washington.
693. Lycæna pseudargiolus var. *violacea* Edw. N. to Alaska.
694. " comyntas Gdt., Rosita (Nash). Also in Atlantic States.

## HESPERIDÆ.

695. Thymelicus garita Reak., Rosita (Nash). N. to Canada.
696. Pamphila uncas Edw., West Cliff, May 25, on the dry bench above creek, abundant at flowers of *Senecio* and *Erysimum*. N. to Canada.
697. Pamphila colorado Scudd., Rosita (Nash). N. to Washington.
698. " rhesus Edw., Rosita (Nash). S. to Arizona.
699. " draco Edw., Rosita (Nash). Colo. only (W. H. Edw., 1884).
700. Pyrgus tessellata Scudd., Rosita (Nash). N. to Canada, also southward.
701. " cæspitalis Bdv., Willow Creek. This species extends downwards, Mr. Nash having taken it at Pueblo. N. W. to Oregon, W. to Cala.
702. Nisoniades juvenalis Fab. Widely distributed, Quebec, Fla., Ariz., etc.
703. " brizo B. and L., Rosita (Nash). N. to Canada.
704. " pacuvius Lintn., Rosita (Nash). S. to N. Mex. and Arizona.
704*a*. " icelus Lintner.
704*b*. " persius Scudder.

## SPHINGIDÆ.

### CHÆROCAMPINÆ.

705. Deilephila lineata Fb., Splann Ranch, May 18, and common generally.

A species of extremely wide distribution, both in altitude and latitude. It is also neotropical.

### SMERINTHINÆ.

706. Smerinthus cerisyi var. *astarte* Streck. This species is boreal. I only took one imago, but the larva was not uncommon.

The late Mr. W. S. Foster informed me that he found *Paonias myops* at Salida, in the lower mid-alpine of Chaffee County.

In "Entom. News," 1891, pp. 190–192, Mr. D. Bruce has a most interesting list of the Sphingidæ of Colorado; would that he more often gave us the benefit of his great knowledge of western Lepidoptera and their habits! There is, however, one thing in the article referred to that I wish to complain of: *Triptogon occidentalis* and *Paonias myops* are said to be "common throughout the State," and there are similar statements regarding several other species. In respect to *D. lineata*, the remark "abundant everywhere," may be allowed to pass; but do *T. occidentalis* or *P. myops* go above the sub-alpine and lower mid-alpine zones respectively? I very much doubt it, especially in the case of the former, although, of course, I would at once cease to question if Mr. Bruce gave definite facts to the contrary. Should it not rather

have been said "Common throughout the State *at suitable elevations?*" Mr. Bruce is by no means specially to blame in regard to looseness of statement; many of our best writers, now and in the past, have been content to jump at conclusions, and assert that insects inhabited "the whole Rocky Mountain region," or "the whole United States," without anything like the amount of information to justify such statements. Owing to this prevalent looseness of statement, accuracy about localities has not been valued, and the science of geographical distribution has suffered greatly.

SESIIDÆ.

707. Sesia n. sp., Ckll.; see "Entom." 1891, p. 229 (foot-note).
708. Sesia aff., sp., with orange wings and strongly pectinated antennæ; near Ula.
708*a*. Sesia sp., near *hylotomiformis* Walk., but bands on abdomen silvery.
708*b*. Sesia n. sp. aff. *pyramidalis* Walk.
708*c*. Euhyparpax rosea Beut. Described from a West Cliff specimen in Bull. Amer. Mus. Nat. Hist., February, 1893, p. 19.
708*d*. Pyrrhotænia coloradensis Beut. Described from a Wet Mountain Valley specimen in Bull. Amer. Mus. Nat. Hist., February, 1893, p. 25.

PERICOPIDÆ.

709. Gnophæla vermiculata Grt. and Rob., abundant; moth bred July 4, and June 28. Also high-alpine.

LITHOSIIDÆ.

710. Lithosia cephalica Grt. and Rob., Cusack Ranch, Willow Creek, August.

ARCTIIDÆ.

711. Euprepia (Platarctia) hyperborea Curt., Short Creek, Cusack Ranch.
712. Arctia blakei Gr.
713. " figurata Drury. One specimen, referred by the late Mr. Hy. Edwards to *A. f.-pallida* Streck.
714. Arctia dieckii Neum.? Cusack Ranch, August (M. E. Cusack); perhaps not distinct from the last.
715. Leptarctia californiæ Walk., near Swift Creek, named for me by Mr. Hy. Edwards as *L. lena* Bdv.
716. Nemeophila petrosa Walk.
717. Halisiodota maculata Harr., the imago taken, and also bred from cocoon found on Round Mountain, Silver Cliff.

SATURNIIDÆ.

718. Attacus gloveri Streck.; see 6th Rep. Colo. Biol. Asso'n, Rosita (Nash); near Ula. Also down to Canon City and Pueblo (Nash).
719. Pseudohazis eglanteria Bdv., Rosita (Nash). Also at Manitou (Packard).

LASIOCAMPIDÆ.

720. Clisiocampa californica* Pack.; common about West Cliff, etc.; abundant near San Francisco (Stretch).

* *Clisiocampa incurva* Hy. Edw. I sent Mr. H. G. Dyar some specimens from Wet Mountain Valley which I had supposed to belong to *californica*, and he informs me that they are typical *incurva*.

721. Clisiocampa sp.; see 4th Rep. Colo. Biol. Asso'n.

The larva of *C. californica*, when newly hatched, is about 2 mm. long, dull black, with long pale hairs.

## AGARISTIDÆ.

722. Alypia lorquinii G. and R., Rosita (Nash). Also at Marshall Pass (Foster).

At lower altitudes this species seems to be replaced by *A. octomaculata*, which Mr. Nash found at Pueblo, and Mrs. Cusack at Colorado Springs.

## COSSIDÆ.

723. Hypopta bertholdi Grote, Cusack Ranch, frequent.

Several specimens of a moderately large Cossid larva, red in color, with a curious caudal horn having an upward curve, were found near the Cusack Ranch on April 1, 1888.

## HEPIALIDÆ.

724. Hepialus hyperboreus Moeschl.

## NOTODONTIDÆ.

725. Cerura sp.

I am sorry my list of the Bombycoid groups is so incomplete. The late Mr. W. S. Foster gave the following list of species which he had taken at Salida, in the lower mid-alpine of Chaffee County, about thirty-five miles northwest of Wet Mountain Valley,—*Attacus gloveri*, *Gloveria arizonensis*, *Seirarctia clio*, *Halisidota trigona*, *H. argentata*, *H. ambigua*, *Ctenucha venosa*, *Cossus reticulatus*, *Arachnis picta* and *Euprepia caia* var. *americana*. *Hemileuca maia* var. *nevadensis* was taken by Mr. Nash in Huerfano County (which borders on Custer County to the south) and at Pueblo. *Ecpantheria reducta* (= *permaculata*), which has been recorded from the Platte Canon, was also found at Salida by Mr. Foster.*

## NOCTUIDÆ.

726. Peridroma saucia Hbn.

727. Noctua clandestina Harris.

727*a*. Carneades satis Harv.? Sent to Mr. Hy. Edwards.

728. Chorizagrotis auxiliaris Grt.; Cusack Ranch, June 18, abundant. Also high-alpine.

729. Chorizagrotis introferens Grt.

729*a*. Tarache angustipennis Grt.? Sent to Mr. Hy. Edwards.

730. Hydrœcia nictitans var. *erythrostigma* Haw., Willow Creek, Cusack Ranch; Short Creek, Aug. 22; also European.

731. Ufeus satyricus Grt., very common in houses.

732. Caradrina civica Grt., West Cliff, June 7. Described from a specimen taken in Colorado by Prof. Snow.

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* Dr. A. S. Packard, in Ann. N. Y. Acad. Sci. May, 1893, pp. 81–82, 89, gives an account of the larvæ of two moths new to our list. These were found in the vicinity of West Cliff, and are identified as—(1) *Ecpantheria permaculata* (Pack.) (2) *Ctenucha cressonana* Grote?

733. Calocampa cineritia Grt. E. to New Jersey. Maine (Mrs. Fernald).
734. Cucullia montanæ Grt. N. to Montana.
735. Plusia gamma subsp. *californica* Speyer, Willow Creek, Cusack Ranch; near West Cliff, May 29.
736. Plusia ni subsp. *brassicæ* Riley, frequently taken; one bred from larva found Aug. 1 at West Cliff; was darker and more suffused than usual, reniform spot rounder below, and separated from orbicular.
737. Plusia u-brevis Brit. Mus. Cusack Ranch, Aug. 1 (M. E. Cusack).
738. Antaplaga dimidiata Grt. Originally described from a specimen taken by Prof. Snow in Colorado.
739. Copablepharon subflavidens Grt., West Cliff, July 25. The specimen is now in Brit. Mus.
740. Heliothis armiger Hbn. Also European and in the tropics; cosmopolitan.
741. " " var. *umbrosa* Grt.
741*a*. Anomis erosa Hbn.? Sent to Mr. Hy. Edwards.
742. Pseudanthœcia tumida Grt.
743. Drasteria erechtea Cram. E. to New Jersey, etc., widely distributed.
744. Catocala mariana Hy. Edw., Willow Creek, Cusack Ranch, Aug. 26.
745. " briseis var. *grotiana* Bailey, Short Creek, Cusack Ranch, Aug. 30. *C. briseis* occurs in New Jersey.
746. Erebus odora L., var. at light, West Cliff, July 30 (Mrs. Charlton).

This specimen has a strong white belt on both wings; whiter and better developed than in any of the Jamaican examples I have seen. Mr. Grote wrote in "Can. Ent." 1887, p. 220, "*Erebus odora* may breed in So. Colorado."

747. Homopyralis discalis Grt.
748. Bleptina caradrinalis Gn., var. The species is in the N. J. list.

*Peridroma saucia* is quoted by Prof. Smith from North and South America, Europe and Asia—a sufficiently wide distribution! *Noctua clandestina* is boreal and widely diffused in N. Amer., where it appears to represent the European *Agrotis obsura* (= *ravida*). The two species are so much alike that Mr. Tutt ("British Noctuæ," vol. ii), judging from superficial appearances, does not separate them; but according to Speyer and Smith, there are good structural characters in the male, making it impossible to rank the two forms as specifically identical. *Chor. auxiliaris* and *C. introferens* both extend to Texas and California. So, of four species of *Agrotis* sens. lat., one is boreal and circumpolar, one is boreal American, and two are western.

## GEOMETRIDÆ.

### ENNOMINÆ.

749. Prochœrodes catenulata Grt.
750. Tetracis sp.
751. Endropia madusaria Walk., Cusack Ranch (M. E. Cusack). E. to New Jersey (Smith).
752. Metrocampa margaritata var. *perlata* Gn., Cusack Ranch (M. E. Cusack) and elsewhere; at light, July 5. The species is European.
753. Sicya macularia Harr. E. to New Jersey.
754. Lychnosea helveolaria Hulst, Cusack Ranch, at light, Aug. 2.

GEOMETRINÆ.

755. Aplodes junctolinearia Graef, Cusack Ranch (M. E. Cusack).
756. Chlorosea bistriaria Pack., West Cliff, July 29, at rest on *Senecio douglasii* var.; also at light.

ACIDALINÆ.

757. Ephyra plantagenaria Hulst.

CABERINÆ.

758. Deilinia variolaria Gn., June 26, etc. E. to New Jersey.
759. " erythremaria Gn. E. to New Jersey.
760. Semiothisa respersata Hulst, West Cliff, May 25.
761. Phasiane curvata Grt., Cusack Ranch (M. E. Cusack).
762. Marmopteryx formosata Streck., Cusack Ranch (M. E. Cusack), and elsewhere in that vicinity, not uncommon.
763. Thamnonoma flavicaria Pack., West Cliff, July 26, both sexes taken flying amongst *Ribes aureum*.
764. Selidosema juturnaria Gn., bet. Wolff's Cabin and Smith's Park, Aug. 7.
765. Fidonia fimetaria G. and R.
766. Gorytodes trilinearia Pack., one taken, 1889.
767. Caripeta niveostriata Hulst MS., Cusack Ranch (R. Cusack); wings red-brown, streaked with white.

LARENTINÆ.

768. Lithostege virginata Graef., Cusack Ranch (M. E. Cusack).
769. Philereme californiata Pack., Cusack Ranch, Willow Creek, Aug. 19.
770. Petrophora testata L., Short Creek, Cusack Ranch, Aug. 21.
771. " populata L., near Swift Creek, frequent.
772. " prunata var. *umbilata* Pack., Cusack Ranch (M. E. Cusack).
773. " montanata Bork., Willow Creek, Cusack Ranch, August.
774. Glaucopteryx cæsiata Bork., var.
775. Eupithecia implicata Walk.

*P. populata* and *G. cæsiata* are recorded by Packard from Labrador. These, with the other species of *Petrophora*, are probably circumpolar; they afford an instance of variable species inhabiting a wide area, the varieties not giving rise to distinct new species, but rather to local races. Butler ("Papilio," 1881, p. 222) has expressed some doubt as to whether the American species called "*cæsiata*" is identical with that of Europe.

PYRAUSTIDÆ.

776. Nomophila noctuella S. V., quite common; Cusack Ranch, August (M. E. Cusack); West Cliff, May 25; July also. Also European, etc.
777. Pyrausta insequalis Gn. E. to New Jersey (Smith).
778. " borealis Pack., West Cliff, July 31, and July 27, at light. Goes northeast to Labrador (Packard).
779. Pyrausta augustalis Grt.
780. " signatalis Walk., West Cliff, July 31, at light.
781. " magdalena Fern. ?, named for me as *plumbofascialis*, and therefore I suppose is *magdalena*; see "Can. Ent." 1892, p. 122.

782. Pyrausta mustelinalis Pack., Cusack Ranch (M. E. Cusack).
783. " fumoferalis Hulst, Cusack Ranch.
784. Loxostege chortalis Grt. E. to New Jersey (Smith).
785. " sp., larva injures alfalfa; see 1st Rep. Colo. Biol. Asso'n.
786. " sticticalis L., West Cliff, July 31, at light; Cusack Ranch (M. E. Cusack). E. to New Jersey (Smith).
787. Loxostege cerealis Zell., West Cliff, etc., abundant; May 23. E. to N. J.
788. Scoparia centuriella S. V., Cusack Ranch, Willow Creek, August.

## PHYCITIDÆ.

### PHYCITINÆ.

789. Dioryctria actualis Hulst, West Cliff, early in June; named for me as *actuella*.
790. Megasis atrella Hulst, described from a specimen sent to Mr. Hy. Edwards, but now in Mr. Hulst's collection. Phycitidæ N. A., p. 166.
791. Plodia interpunctella Hbn., West Cliff (introduced); larvæ found at West Cliff in a box of crackers from Denver. E. to N. J. (Smith).

### PEORIINÆ.

792. Ragonotia saganella Hulst, West Cliff, May 24, at light; see Hulst, Phycitidæ of N. A., p. 205.
793. Altoona ardiferella Hulst, West Cliff, at light, July 31; this was only the second specimen known.

## CRAMBIDÆ.

794. Crambus innotatellus Walk., West Cliff, amongst herbage, July 26 and Aug. 1.
795. Crambus ruricolellus Zell., West Cliff, Aug. 1.
796. " caliginosellus Clem., West Cliff, at light, July 31. E. to New Jersey (Smith).
797. Crambus luteolellus var. *ulæ* Ckll., the original specimen was sent to Prof. Fernald. It seems to me to be a distinct variety, but I judge only from a comparison of descriptions; see "Ent. Mo. Mag." May, 1888, p. 272.

## PTEROPHORIDÆ.

798. Platyptilia carduidactyla Riley, Cusack Ranch.
799. Œdematophorus griseus Walsm., Willow Creek, Cusack Ranch, Aug. 25.
800. " inquinatus Zell. (= *ambrosiæ* Murtf.), near West Cliff; the specimen now in Lord Walsingham's collection.
801. Leioptilus helianthi Wlsm., Short Creek, Cusack Ranch, Aug. 21.
802. " subochraceus Wlsm., Smith's Park, Aug. 7.
803. " sulphureodactylus Pack., a specimen found at Ula, July 30, is probably this.

A *Platyptilia*, not identified (the specimen is with Lord Walsingham), was bred from larva on *Castilleia pallida* var. *acuminata* at West Cliff.

## ORNEODIDÆ.

804. Orneodes hexadactyla L., West Cliff, etc., common; Cusack Ranch, Aug. 2; West Cliff, July 31; abundant, April 3. Also European; see "Ent. Mo. Mag." 1889, p. 213.

### TORTRICIDÆ.

805. Ptycholoma persicana Fitch. E. to New Jersey (Smith).
806. Sericoris vetulana Wlsm., Cusack Ranch, Aug. 2.
807. Pædisca ridingsana Rob., West Cliff, July 29.
808. " fernaldana Grt., Cusack Ranch, Aug. 2.
809. " culminana Wlsm., Cusack Ranch, Willow Creek.
810. Semasia olivaceana Riley, Cusack Ranch, Willow Creek.
811. " tarandana Moeschl., West Cliff, May 24.
812. Carpocapsa pomonella L., West Cliff (in imported apples). A European species. Not really belonging to the fauna of our district.

### PLUTELLIDÆ.

813. Plutella cruciferarum Zell., West Cliff, May 25, locally abundant; also European.

### GELECHIIDÆ.

814. Psecadia semilugens Zell.
815. Walshia amorphæella Clem., Willow Creek, Cusack Ranch, August.
816. Gelechia gallæ-solidaginis Riley, galls only found. E. to New Jersey (Smith).
817. Depressaria sp., at light, April 12. I may have taken more than one species of this genus. One specimen was referred with doubt to *D. hilarella* Zell.

### LAVERNIDÆ.

818. Laverna definitella Zell., Willow Creek, Cusack Ranch, August.

### LITHOCOLLETIDÆ.

819. Lithocolletis sp., on *Populus tremuloides*.
820. " sp., on *Salix*.

### COLEOPHORIDÆ.

821. Coleophora sp., larvæ in cases on *Bigelovia*, West Cliff.

## HETEROPTERA.

Of 43 species identified, 28 are boreal or widely distributed, 13 are western, and 2 southern.

### SCUTELLERIDÆ.

822. Homæmus bijugis Uhler, on timothy grass, ♂ and ♀, Cusack Ranch, Willow Creek, Aug. 21.
823. Eurygaster alternatus Say. Northeast to Muskoka Lake District, Can. (Van Duzee); also in Summit County.

### CORIMELÆNIDÆ.

824. Corimelæna nitiduloides Wolff. East to New Jersey (Smith),

### PENTATOMIDÆ.

#### ASOPINÆ.

825. Perillus confluens H.-Sch. Uhler gives "S. W. States."

826. Perillus exaptus Say, Ula, Nov. 12. E. to New Jersey region* (Smith).

PENTATOMINÆ.

827. Euchistus variolarius Pal. Beauv., West Cliff, May 23, by sweeping *Thermopsis*. E. to New Jersey (Smith).

828. Hymenarcys æqualis Say, near West Cliff, July 30. E. to New Jersey region (Smith).

COREIDÆ.

ALYDINÆ.

829. Alydus eurinus Say, Ula, July 30. Also high-alpine; but in Mesa County at about 7000 feet. Northeast to Muskoka Lake District, Canada (Van Duzee).

RHOPALINÆ.

830. Harmostes reflexulus Stal., near West Cliff, end of July. Uhler writes "Western States."

831. Corizus hyalinus Fb., Ula, July 30. Also high-alpine. "Western States" (Uhler, Check-List, 1886).

LYGÆIDÆ.

NYSIINÆ.

832. Nysius sp., Ula, July 30.

CYMINÆ.

833. Cymus luridus Stal., near West Cliff, end of July. N. E. to Muskoka Lake District (Van Duzee).

GEOCORINÆ.

834. Geocoris decoratus Uhl., Ula, Nov. 12. "Western States" (Uhler, Check-List).

MYODOCHINÆ.

835. Pamera fallax Say. Not in Uhler's Check-List.

836. Emblethis arenarius L. E. to New Jersey region (Smith).

837. Peritrechus fraternus Uhl., Ula, Nov. 12. E. to N. J. region (Smith).

838. Eremocoris ferus Say. E. to New Jersey region (Smith).

LYGÆINÆ.

839. Melanocoryphus facetus Say. Also in Chaffee County. "Southern States" (Uhler).

840. Melanocoryphus admirabilis Uhl., Ula, Nov. 12. "Western States" (Uhler).

841. Lygæus kalmii Stal. E. to New Jersey region (Smith).

842. " reclivatus Say, Ula, Nov. 12. "Western States" (Uhler). Also at Fort Collins (Riley and Blount).

*L. turcicus* Fab., occurs at the lower end of Wet Mountain Valley, just in Fremont County.

* Prof. Smith includes in his New Jersey Catalogue (1890) many species which "may reasonably be expected to be found," but have not actually occurred in the State. This method is rather confusing, and likely to lead to errors of citation, but for present purposes it is enough to cite as above.

## CAPSIDÆ.

### MININÆ.

843. Miris affinis Reut., Ula, July 30. N. E. to Muskoka Lake District (Van Duzee).

### LOPARIINÆ.

844. Lopidea media Say, on *Glycyrrhiza lepidota*, etc., West Cliff, July 31. E. to New Jersey region (Smith). Down to Pleasant Valley, Fremont County.

845. Hadronema militaris Uhl., Smith's Park, Aug. 6. Also high-alpine. "Western States" (Uhler).

### PHYTOCORINÆ.

846. Calocoris rapidus Say. N. E. to Muskoka Lake District (Van Duzee).

847. " superbus Uhl., West Cliff, July 31. "Western States" (Uhler)

848. " sp. probably var. of *rapidus*, West Cliff, May 23, by sweeping *Thermopsis*.

### CAPSINÆ.

849. Lygus annexus Uhl. "Western States" (Uhler).

850. " pratensis L., var. West Cliff, July 27. Also high-alpine; and N. E. to Muskoka Lake District (Van Duzee).

851. Lygus pratensis var. *lineolaris* (Pal. Beauv.).

852. Poeciloscytus unifasciatus Fab., Smith's Park, Aug. 6, Muskoka Lake District (Van Duzee).

853. Poeciloscytus sp., West Cliff, July 27.

854. Capsus brachycorus Uhl., near West Cliff, end of July. "Western States" (Uhler).

*Lygus diffusus* Uhl., is high-alpine in Custer County.

### CALLECORINÆ.

855. Sthenarops chloris Uhl., West Cliff, by sweeping herbage, July 25. E. to New Jersey region (Smith).

856. Stiphrosoma stygica Say, West Cliff, July 27; Ula, July 30. N. E. to Muskoka Lake District (Van Duzee).

### PLAGIOGNATHINÆ.

857. Plagiognathus obscurus Uhl., West Cliff, July 27. N. E. to Muskoka Lake District (Van Duzee).

## ACANTHIIDÆ.

### ANTHOCORINÆ.

858. Anthocoris musculus Say. N. E. to Muskoka Lake District (Van Duzee).

859. " melanocerus Reut., West Cliff, May 22. Also high-alpine, Uhler (Check-List) gives only Colorado. I also found it at the mouth of Slate Creek, Summit County, amongst willows, on Aug. 27.

### CIMICINÆ.

860. Cimex lectularius L., West Cliff, too frequent.

## TINGITIDÆ.

### PIESMINÆ.

861. Piesma cinerea Say, West Cliff, July 27. E. to New Jersey region (Smith).

TINGITINÆ.

862. Corythuca ciliata Say. E. to New Jersey region (Smith).

863. " sp., body black, legs and antennæ dark brown, elytra white, on *Cnicus*, in numbers. West Cliff, June 12 (? = *ciliata* Say).

ARADIDÆ.

864. Aradus sp. The species from our district was not identified. In Delta County I found *A. tuberculatus* Kirby, and in Summit County *A. rectus* Say.

NABIDÆ.

CORISCINÆ.

865. Coriscus inscriptus Kirby, West Cliff, July 27. Also sub-alpine; also in Chaffee, Gunnison and Pueblo Counties.

866. Coriscus ferus L., Ula, Nov. 12, West Cliff.

Both these species are recorded by Mr. Van Duzee ("Can. Ent." 1889, p. 5) from the Muskoka Lake District, Canada.

REDUVIDÆ.

ACANTHASPIDINÆ.

867. Conorhinus sp. The genus is southern and neotropical.

HYDROBATIDÆ.

868. Limnotrechus marginatus Say, common on Grape Creek, West Cliff, May 25. N. E. to Muskoka Lake District (Van Duzee).

VELIIDÆ.

869. Hebrus sobrinus Uhl., Ula, Nov. 12, a specimen doubtfully referred to this. "Western States" (Uhler).

SALDIDÆ.

870. Salda interstitialis Say, Ula, Nov. 12. N. E. to Muskoka Lake District (Van Duzee).

871. Salda humilis Say, West Cliff, July 31. E. to New Jersey region (Smith).

## HOMOPTERA.

CICADIDÆ.

872. Cicada sp., on *Populus tremuloides*.

MEMBRACIDÆ.

SMILIINÆ.

873. Publilia modesta Uhl., on *Gymnolomia multiflora*, Cusack Ranch.

874. Stictocephala sp.

CECROPIDÆ.

GLYPONINÆ.

875. Xerophloea peltata Uhl.

TETTIGONINÆ.

876. Proconia costalis Fab., Ula, Nov. 12; West Cliff, March 31. Also subalpine; and E. to New Jersey region (Smith).
877. Tettigonia limbata Say.
877*a*. Diedrocephala mollipes Say.

BYTHOSCOPIDÆ.

878. Bythoscopus clitellarius Say.
879. " sp., near West Cliff.
880. Idiocerus alternatus Fitch, West Cliff, July 31. Also high-alpine. Recorded rather doubtfully by Mr. Van Duzee from the Muskoka Lake District, Canada. New Jersey region (Smith).
880*a*. Pachyopsis lætus Uhler.

PSYLLIDÆ.

APHALARINÆ.

881. Aphalara harrisii, near West Cliff.
882. " marginata Riley.

APHIDIDÆ.

APHIDINÆ.

883. Aphis brassicæ L., on cabbage; see 3d Rep. Colo. Biol. Asso'n.
884. Siphonophora sp., on *Gymnolomia multiflora*, Cusack Ranch.
885. Aphis (sens. Linn.) sp., dull bluish green, darkish on back, on *Clematis douglassii*, Beddoes' Old Ranch.
886. Aphis sp., bright scarlet, femora and tibiæ pale brown, tarsi blackish, wings hyaline, on *Rudbeckia laciniata*, Beddoes' Old Ranch.
887. Aphis sp., dull gray or dark sepia brown, rather elongated, on *Echinospermum floribundum*, below the Micawber.
888. Aphis sp., gray, wings hyaline, veins not darkened, on *Gentiana heterosepala*, near Wolff's Cabin.
889. Aphis sp., rather large, yellowish green, very shiny, tarsi black or blackish, on *Erigeron glabellus* var. *mollis*, near Smith's Park.
890. Aphis sp., dark brown, younger ones dark gray with darker legs, on *Arabis*, near Smith's Park.
891. Aphis sp., green, femora partly black, on *Arabis*, above Smith's Park.
892. " sp., small, dark gray or black, crowded on underside of leaves of *Salix*, near West Cliff.
893. Aphis sp., black, wings hyaline, young gray, on undersides of leaves of *Cornus stolonifera*, Willow Creek.
894. Aphis sp., dull brownish-vinous, head bluish gray, on underside of leaf of *Lonicera involucrata*, Willow Creek.
895. Aphis sp., smallish, oval, wings hyaline, slightly grayish, body dark lead gray, tibiæ and basal half of antennæ very pale yellowish, in vast numbers on the leaves of *Veratrum californicum*, Willow Creek.
896. Aphis (sens. Linn.) sp., dull scarlet, legs and antennæ blackish, but basal half of femora pale yellowish; one that had just cast its skin had legs and antennæ entirely pale yellowish, cast skin whitish, with dark legs and antennæ; on involucre of *Solidago*, Willow Creek.

897. Aphis sp., dark gray with pale legs and antennæ; on *Epilobium angustifolium*, Willow Creek.

898. Aphis sp., large, pale whitish green, with a green dorsal line, legs long, tarsi black; on *Thermopsis*. Willow Creek.

899. Aphis sp., head and thorax red-brown, abdomen dark purplish gray, on *Cnicus ochrocentrus*, Ula, July 30.

900. Aphis sp., dark gray, the young slightly brownish, on *Astragalus*, Ula, July 30.

901. Aphis sp., very dark brownish gray, on *Castilleia integra* var. *gracilis*, Cusack Ranch, Aug. 3.

902. Aphis sp., elongate-oval, black, on *Populus tremuloides*, September 13.

## COCCIDÆ.

### LECANIINÆ.

903. Orthezia occidentalis Dougl., found in nest of dark brown ant with large head and shiny abdomen. Specimens are in Brit. Mus. and U. S. Nat. Mus.; see "Ent. Mo. Mag." Sept., 1891, p. 245.

904. Pulvinaria* n. sp., on *Bigelovia* at West Cliff. Specimens with Mr. Douglas.

### COCCINÆ.

905. Coccus cacti† L., "Ent. Mo. Mag." 1889, p. 382. No adults in condition for examination were found, but I think the species is correctly identified.

---

* P. S., June, 1893. I have now received excellent specimens of the *Pulvinaria*, and am able to submit a description.

*Pulvinaria bigeloviæ* n. sp., ♀ with ovisac 10 mm. long. Scale dark brown. Ovisac white, elongate, firm, obscurely grooved, parallel sided. Boiled in caustic soda, the scale turns the liquid pink. Antennæ 8-jointed, joints 2 and 3 subequal and longest; 4 shorter than 3, but longer than 5; 5 and 8 subequal; 6 and 7 subequal and shortest; 8 seems as if divided into two; 8 bears several rather short hairs; 4 and 5 each with a short bristle; 2 with two short bristles. Tarsus about three-fourths length of tibia. Femur stout, very little longer than tibia. Claw large, tarsal knobbed hairs and digitules of claw fairly stout, with distinct knobs. Tarsal knobbed hairs rather short, extending only as far as the digitules. Tibia with three bristles on innerside. Trochanter with one long hair. Anal plates pale brown, short, posterior external side a little longer than anterior external side. Anal ring with six stout bristles. Lower lip with two spines on each side, one subterminal, the other lateral, margin with a few small simple spines.

Described from specimens found by Mr. Frank Cusack, at West Cliff, June 16.

In size and general appearance this species reminds one of *P. urbicola* Ckll., which is found on *Capsicum* in Jamaica.

† P. S., July 5.—What has been called *Coccus cacti* proves to consist of at least three species, and there is no reason to suppose that the true *C. cacti*, as described by Signoret, occurs in the Rocky Mountain region. Dr. A. Dugès has found a species at Guanajuato, Mex., which Lichtenstein, in 1884, referred to *Acanthococcus tomentosus* (= *Coccus tomentosus* Lam., considered by Signoret a synonym of *cacti*). Dr. Dugès has kindly sent me specimens of this species, which is certainly distinct from *cacti*. At Las Cruces, N. Mex., I have found a species congeneric with, but distinct from, *A. tomentosus*; this I propose to call *A. confusus*

906. Rhizococcus n. sp., under a rock, West cliff, April 23, 1890. Naked, pyriform, 2¼ mm. long, dull lilac, legs clear red-brown, antennæ reddish brown. Caudal filaments short, but distinct. This must be new, but unfortunately the only specimen was accidentally lost, and no proper description can be drawn up.

DIASPINÆ.

907. Chionaspis salicis L., on willow at West Cliff.

On lemons exposed for sale in the shops were found *Mytilaspis citricola* and *Aspidiotus nerii*, but these of course do not belong to the fauna.

## DIPTERA.*

CECIDOMYIDÆ.

908. Cecidomyia rigidæ O. S., West Cliff; see "Entom." p. 1890, 278.
909. " salicis-batatas Walsh; see "Entom." 1890, p. 279.
910. " salicis-brassicoides Walsh; see "Entom." 1890, p. 280.
911. " frater Ckll., "Entom." 1890, p. 280. Type in Brit. Mus.
912. " salicis-nodulus Walsh?; see "Entom." 1890, p. 75.
913. " salicis-hordeoides Walsh?
914. " bigeloviæ Ckll., "Ent. Mo. Mag." 1889, July, p. 324; Aug. p. 363; "W. Am. Sci." 1889, p. 106; "Ent. Mo. Mag." 1890, p. 109. Specimens in Brit. Mus.
915. Cecidomyia alticola Ckll., "Entom." 1890, p. 281. Type now in Brit. Mus.
916. " albovittata Walsh?; "Entom." 1890, p. 282.
917. " sp., galls on *Geranium;* imago unknown.
918. " ? sp., gall on *Populus tremuloides.*
919. Hormomyia salicum Ckll. A problematical species, the gall only being known. Trans. Ent. Soc. Lond., 1890, xvi–xvii.

MYCETOPHILIDÆ.

920. Leja sp., near West Cliff.

SIMULIIDÆ.

921. Simulium sp., attacking horses, July 8; see 2d Rep. Colo. Biol. Asso'n.

CULICIDÆ.

922. Culex sp.

CHIRONOMIDÆ.

923. Ceratopogon sp., figured in 13th Rep. Colo. Biol. Asso'n; see also 2d Rep.

n. sp. It differs from *tomentosus* in the secretion of the individuals being very abundant, so that they cannot easily be separated from one another, the white cottony matter from several being fused together; also in the more slender legs; and in the narrower and longer truncate spines or processes; and apparently in the fewer joints of the antennæ. The Wet Mountain Valley insect is in all probability identical with *A. confusus.*

* Prof. C. H. T. Townsend has lately identified the following Diptera, collected by me in Wet Mountain Valley: *Sarcophaga* sp., 12 mm. long, ♀. *Cleigastra* sp. *Schoenomyia* sp. "Appears to belong to this anthomyiid genus, but does not agree with the characters wholly, 8 mm. long and very bristly." *Jurinia algens* Wd. *Onesia* sp.? ♂. *Caricea* sp.? ♀. *Cyrtoneura* sp. ♀.

TIPULIDÆ.

924. Tipula sp.

TABANIDÆ.

925. Tabanus sp., near *affinis.*
926. " sp.
927. Chrysops sp., common and very troublesome; called "deer fly."

LEPTIDÆ.

928. Chrysopila sp., near West Cliff.

ASILIDÆ.

929. Cyrtopogon? sp.
930. Stenopogon sp., "Can. Ent." 1889, p. 60.

EMPIDÆ.

931. Tachydromia sp., near West Cliff.

DOLICHOPODIDÆ.

932. Argyra? sp., near West Cliff.

SYRPHIDÆ.

933. Crioprora cyanogaster Lw., West Cliff. E. to New Jersey (Smith).
934. Eristalis hirtus Lw., see 8th Rep. Colo. Biol. Asso'n.
935. Melanostoma cærulescens Willist., see 8th Rep. Colo. Biol. Asso'n.
936. Microdon n. sp. Specimen in Brit. Museum.
937. Volucella sp.; colored like *Bombus rufocinctus.*

TACHINIDÆ.

938. Gonia exul Willist., West Cliff, May 16.
939. " frontosa var. *atra* Ckll., 10th Rep. Colo. Biol. Asso'n; "West Am. Sci." 1889, September, p. 106.
940. Dejeania vexatrix O. S., see 8th Rep. Colo. Biol. Asso'n.

SARCOPHAGIDÆ.

984.* Sarcophaga sp.

DEXIIDÆ.

985. Dexia sp.

MUSCIDÆ.

941. Lucilia cæsar L.
942. Musca domestica L.
943. " sp.

ANTHOMYIDÆ.

944. Anthomyia sp., near West Cliff.

CORDYLURIDÆ.

945. Scatophaga sp.

* This and some others whose numbers do not come in their proper order, were added since the list was made up. The same is the case with a few species whose numbers are followed by a letter.

### MICROPEZIDÆ.

946. Calobata sp. Specimen sent to Dr. Riley.

### TRYPETIDÆ.

947. Scriptotricha culta Wied., found ovipositing in thistle buds, July 9; see also 6th Rep. Colo. Biol. Asso'n. S. to Carolina and Texas.
948. Trypeta bigeloviæ Ckll., West Cliff, common; Dora; Round Mountain.
949. " " var. *disrupta* Ckll., with the type; see "Ent. Mo. Mag." 1890.
950. Trypeta? sp., a supposed Trypetid gall on *Oxytropis lambertii*, imago unknown.
951. Trypeta sp., aff. *humilis* Lw., near West Cliff.

### PIOPHILIDÆ.

952. Piophila sp., near West Cliff.

### PULICIDÆ.

953. Pulex sciuri ?, on *Tamias lateralis*.
954. " serraticeps ?
955. " sp., on fowls; see 9th Rep. Colo. Biol. Asso'n.

## ARACHNIDA.

### ARANEÆ.

956. Dictynidæ: *Dictyna* sp.
957. Agalenidæ: *Agalena nævia* Walck.
958–62. Theridiidæ: *Theridium* sp.; *Lithyphantes* sp.; *Euryopis* sp.; *Linyphia* sp.; *Erigone* sp.
963. Epeiridæ: *Epeira* sp.
964. Tetragnathidæ: *Tetragnatha* sp.
965–69. Thomisidæ: *Xysticus cunctator* Thor.,* forms *pallidus* Ckll., and *nigrescens* Ckll. (see "Ent. Mo. Mag." 1890, p. 191); *Coriarachne* sp.; *Misumena* sp.; *Philodromus* sp.
970–71. Lycosidæ: *Lycosa*, two spp.: *Tarentula* sp.
972. Attidæ: gen.? sp.? a species with the dorsum of abdomen red.

### SOLPUGÆ.

973. A large species of this group is found by Swift Creek.

### OPILIONES.

974. Phalangium sp.
975. Opilio sp.
976. Phalangodes robustus (Pack.). Swift Creek, "Can. Ent." 1889, p. 140.

* The two forms mentioned may be described, more fully than in the place cited, as follows: (1) *pallidus*. Cephalothorax with a broad dorsal pale band (about 1½ mm. broad); this band without any distinct markings; lateral bands of cephalothorax gray; abdomen obscurely marbled greenish and paler; legs pale; (2) *nigrescens*. Cephalothorax with the dorsal pale band not reaching its posterior end, but ending posteriorly in a point; this band with markings nearly as in the type; lateral and posterior areas of cephalothorax black, with a little pale marbling above legs; abdomen obscurely marbled reddish brown and paler; legs darker.

PSEUDOSCORPIONES.

977. gen.? sp.? A dark brown species under rocks, Old Beddoes' Ranch. A different species was found at the Cusack Ranch.

ACARI.

978. Ixodes sp. Only occasionally found.

MYRIOPODA.

979. Parajulus venustus (Wood), see Proc. U. S. Nat. Mus. 1888, p. 343.

980. Geophilus umbraticus McNeill., see Proc. U. S. Nat. Mus. 1888, p. 346.

981. Lithobius kochi Stuxb. var. *coloradensis* v. nov., see Proc. U. S. Nat. Mus. 1888, p. 348. Mr. Bollman gave a description of this form, which he at first thought to be a new species, but it differs little from true *kochi*, found at Sancelito, Cal. I give it a varietal name to indicate that there is a difference between the two forms, so widely separated geographically.

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P. S. Dec. 22.—*Photopsis east of Colorado.*—The statement on p. 343, that no *Photopsis* is known east of Colorado, must be modified. In the Washburn Colledge Bulletin for 1886, p. 211, is a list of Hymenoptera found in Barber County, Kansas, in which are included *Photopsis tapajos* Blake, and *P. unicolor* Cress.

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The names of new genera and of new species are followed by the name of the Author.


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## ERRATA.

Page 51, line 11, for *Carysta* read *Caryota*.
" 52 and 54, for Q. M. Fenn read G. M. Fenn.
" 55, line 34, for gnava read gnava.
" 308, line 12, for *nigratoria* read *migratoria*.
" 314, line 17, dele comma after always.
" 318, line 38, for Prestwick read Prestwich.
" 325, No. 68, for æreus read æneus.
" 341, line 22, before BEMBECINÆ, add **BEMBECIDÆ**.
" 348, No. 540, after Aldrich add Ranch.
" 349, " 572, for **Brassus** read **Bassus**.
" 350, " 598, for **cupeipes** read **cupreipes**.
" 352, " 626, after bred add from.
" 352, line 43, for PARNASIINÆ read PARNASSIINÆ.
" 353, line 12, for *nitulus* read *rutulus*.
" 355, Nos. 704*a*, 704*b*, add, these two taken by my brother, L. M. Cockerell.
" 356, No. 708*c* is misplaced, and should follow No. 725 on page 357.
" 356, No. 717, for **Halisiodota** read **Halisidota**.
" 358, in notes after No. 748, line 4, for *obsura* read *obscura*.
" 365, No. 885, for *douglassii* read *douglasii*.
" 366, No. 903, *Orthezia* does not belong to Lecaniinæ, but apparently forms a new subfamily. It is perhaps the oldest living type of Coccidæ.

Page 366, at bottom, to P. S. July 5.—*Acanthococcus tomentosus* and *A. confusus* now prove to be strictly congeneric with *Cozcus cacti*, and are therefore to be placed in *Coccus*.

Page 369, No. 971, for *Tarentula* read *Tarantula*.
" 370, No. 978. **Ixodes**. Probably not of this genus as now restricted.

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